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THE GROSS EARNINGS OF RAILWAYS in the United States for the month of August, 1891, as reported by the *Financial Chronicle*, show on the whole very irregular results. The final aggregate of earnings shows considerable improvement over that reported for the corresponding month of last year, viz., an increase of $2,892,942 or 7.21%; but when the earnings of the various roads are considered in detail, the exhibit is less favorable. The aggregate increase is due largely to the heavy gains of a comparatively few lines. The total number of roads included in the returns is 143, and of this number 51 show decreases. Twenty-two systems exhibit increases of over $40,000 each, and a total increase of $2,916,722, which is $13,780 more than the aggregate for the total 143 lines. These 22 are composed mostly of the grain carriers, with two Southern roads and a few coal roads. Considered by groups, the Middle and Middle Western roads exhibit the best results, only 13 out of 58 showing decreases. In the South, Southwest, and Northwest the results are generally unfavorable as compared with those of last year, although a few separate systems show very large gains. In general the returns show the varying nature of the influences at work, some favorable and some unfavorable.

A LONG DISTANCE FAST RUN was made on the New York Central & Hudson River R. R. Sept. 14, by a train which ran the 436⅛ miles from New York to East Buffalo in 439½ minutes, without allowing for stops. To the central station in Buffalo, 440 miles, the time was 448 mins., or 433 mins. 44 secs., allowing for stops. A hot box reduced the record, as the 361 miles to Fairport were made in 361 minutes. The run of 143 miles from New York to Albany was made in 140 minutes from Albany to Syracuse, 148 miles, in 146 minutes; and from Syracuse to East Buffalo, 145.6 miles, in 147½ minutes, including a 7 minutes' stop to attend to the hot box. Deducting stops, the actual running time to East Buffalo was 426 minutes, or at the average rate of 61.44 miles per hour. The train consisted of three heavy cars, equal in weight to five ordinary cars. It was made up of a drawing-room car, buffet car, and Superintendent VOORHEES' private car, the weights being 93,400 lbs., 77,800 lbs., and 88,400 lbs., or a total of 259,600 lbs. The engine weighed 60 tons, and the tender, loaded, 40 tons, making a total load of engine and train of about 230 tons. The run was made with three engines, all of the eight-wheel type, and all of similar dimensions, with the exception that engine No. 870, which hauled the train from New York to Albany, had driving wheels 6 ft. 6 ins. in diameter, while the others had driving wheels 5 ft. 9 ins. in diameter. The leading dimensions of engine No. 870, the only one on the road with such large driving wheels, are as follows: Cylinders, 19 × 24 ins.; wagon top boiler, 58 ins. diameter, with 268 tubes 2 ins. in diameter and 12 ft. long; grate, 96 × 40¾ ins.; heating surface, 1,821.5 sq. ft.; grate area, 273 sq. ft.; height from rail to center line of boiler, 8 ft. 7½ ins.; truck wheel base, 6 ft. 8 ins.; driving wheel base, 8 ft. 6 ins.; total wheel base, 23 ft. 11 ins.; weight on truck wheels, 40,000 lbs.; weight on driving wheels, 80,600 lbs. The tender has a capacity of 6¾ tons of coal. The run is remarkable for the high speed maintained during such a long run, and it is an indication of the possible increase in schedule time for fast trains which has already been suggested in connection with the World's Fair traffic in 1893. A regular train is now to be put on which is to make the run of 440 miles between New York and Buffalo at the average speed of 55 miles per hour. In our last issue we recorded a short distance fast run on the Philadelphia & Reading R. R., in which a speed of 90.5 miles per hour was attained.

NICKEL-STEEL PROTECTIVE DECK PLATES were tested at Annapolis on Sept. 12. The target was made of two 1½-in. plates and placed almost horizontally, or at an angle of 2° with the horizon. The gun used was a 6-in. rifle loaded with a 100-lb. armor-piercing projectile. Two targets were tested, one made of two all-steel plates and the other of nickel-steel plates, both of the thickness given above. The steel target was perforated, the projectile, which was broken, passed through both plates, through 2 ft. of oak and 8 ft. of earth backing, completely wrecking the target support. The velocity of this shot was 1,780 ft. per second. The nickel steel target received a shot delivered with a muzzle velocity of 1,873 ft. per second. But the projectile glanced off without rupturing the plates, and was itself broken to pieces. The only effect was a crack in one plate 5 ins. long and an indentation between 3 ins. and 5 ins. deep. The projectile was made of tempered steel, and was shattered into small fragments.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a derailment on the narrow gage Union Pacific, Denver & Gulf line of the Union Pacific Ry., near Beaver Brook, Col., Sept. 13. A passenger train for Denver was running at considerable speed to make up time, and when rounding a sharp curve the express car left the track and rolled down a 15-ft. bank, was followed by the mail car and two passenger coaches, one of which turned over twice before reaching bottom in the water. The stream was rushing along so fiercely that the cars were carried down with it some distance. The work of rescuing those caught in the cars was rendered extremely difficult, and several of the rescuers were badly hurt by being thrown against the great boulders in the creek. About 20 persons were injured, 5 fatally. A train on the Long Island R. R. ran past the signals at the Newtown Creek drawbridge, the draw being open, and was derailed by the safety derailing switch provided for such an emergency. The engine driver and fireman have been discharged. This safety appliance prevented what might have been a serious accident.

THE GREAT FLOODS IN SPAIN, of this and last week, caused the loss of 3,000 lives in Consuegra, says the Mayor of that town. Heavy continuous rains swelled the mountain torrents that pour into the Amarguillo, and carried away four stone bridges, mills, houses and villages. The town of Consuegra lies 60 miles south of Madrid, and had 7,000 inhabitants. The flood came so suddenly and in such volume that few in the lower valley escaped, says the accounts.

SMOKELESS POWDER, invented by Prof. C. E. MUNRO, chemist of the naval torpedo station at Newport, and by Commander JEWELL, U. S. N., has been recently tested at Indian Head, with 3 and 6 pounder rapid fire guns. Eleven rounds were fired from the 6-pounder and eight from the 3-pounder. The results obtained in the 3-pounder were somewhat more favorable than have been obtained abroad, while those in the 6-pounder were about equal to the results obtained in Europe with the same sized gun. The powder is almost entirely smokeless, giving off only a slight haze, which is quickly dissipated. As with European smokeless powders, a small priming charge of black powder must be used, as the smokeless grains are difficult of ignition. This priming charge makes a slight puff of gray smoke, which quickly disappears. The extreme regularity, uniformity and correspondence of velocities, with pressures which were apparent throughout the tests, are favorable features. In addition, good results have been obtained with a grade of the compound intended for the musket calibre. Sufficient data have been obtained to give assurance that the problem of smokeless powder for rapid fire guns, up to and including the 5-inch calibre, has been solved, and there does not appear to be any reason why favorable results should not be obtained with the 6-inch calibre. Beyond the latter the bureau of ordinance is not prepared to make any statement at present. The new powder will soon be tested in a 4-inch gun.

THE BIRKENHEAD TRAMWAY CO., organized on Aug. 30, 1870, by GEORGE FRANCIS TRAIN, lately celebrated its 21st anniversary. This was the first tramway in England. Since that year 948 miles of tramways have been built with a paid up capital of over $67,000,000. The combined lines own 3,891 cars, 27,710 horses and in 1890 they carried over 520 million passengers.

THE SAULT STE. MARIE CANAL, Canadian side, is to be deepened to 19 ft. by order of the authorities at Ottawa. Including the deepening of harbors and approaches, the total cost of the work would be $4,000,000.

THE LOCKPORT, N. Y., WATER POWER CANAL SCHEME will probably fall, owing to the late report upon its probable cost by Mr. C. B. BRUSH, M. Am. Soc. C. E. Mr. BRUSH was employed by the Business Men's Association to make a careful survey to the Niagara River, and to estimate the cost, etc. He figures this cost at about $9,000,000, or two or three times the original estimate of the promoters. There are 2 miles of heavy rock excavation.

THE ZONE-TARIFF IN HUNGARY, according to the last report of the Minister of Finance, shows a deficiency in revenue of $900,000 for the Hungarian State railways, as compared with the first 6 months of 1890. The actual receipts were only $15,000 in excess of the preceding period, and the working expenses and necessary repairs increased. The passenger traffic, however, has certainly increased. The Hungarian State lines carried 5,960,000 passengers in 1888, 9,340,000 in 1889, and 15,080,000 in 1890. From the figures the ordinary growth of say 10% should be deducted to obtain the figures due to the zone-tariff system. New lines opened in 1889-90 amounted to 346 and 505 miles, and this must be considered. The Minister figures that the actual increase in traffic due to the reduced tariff was 1,980,000 in 1889, and 5,030,000 in 1890, or quite 70% for 1890 compared with 1888. Financially, however, the scheme is pronounced a failure.

THE PRUSSIAN STATE RAILWAYS have formally adopted the Westinghouse brake and, it is said, will have to replace with them about 5,000 of the Carpenter brakes now condemned. The New South Wales railways have also recently adopted the Westinghouse, and have thus made that brake a standard for Australia. The orders from that continent are said to aggregate 10,000 sets.

THE CAPE COD CANAL CHARTER will now revert to the old company, provided the directors deposit $100,000 in the Massachusetts State Treasury before Nov. 1. This is owing to the failure of the Canadian syndicate to make its deposit before Sept. 9 to secure the late charter they obtained from the legislature. This deposit was to be $500,000 in cash. Report has it that the old company will at once resume work.

Project for a Canal Lock of 20 Meters (65.6 feet) Lift.

In canal transportation the question of a quick transfer of boats from one level to another is a matter of very great importance. In the case of locks there are three different operations to be considered as a boat goes from the upper to the lower level. First, there is the entrance of the boat into the lock and the closing of the upper gates; second, the filling of the lock; and third, the opening of the lower gates and the exit of the boat into the lower level. In passing upward the reverse order obtains. The length of time required to make the lockage is about the same in each case. Where there is a great difference of level in the surface of the water in the two parts of the canal and a number of locks have to be used, there is a great deal of time employed at the entrance to each one of the locks and also at the exit. If, for example, all the locks could be superposed there would be required but one operation for entering or leaving, and the time lost in performing it at the remaining locks would be saved.

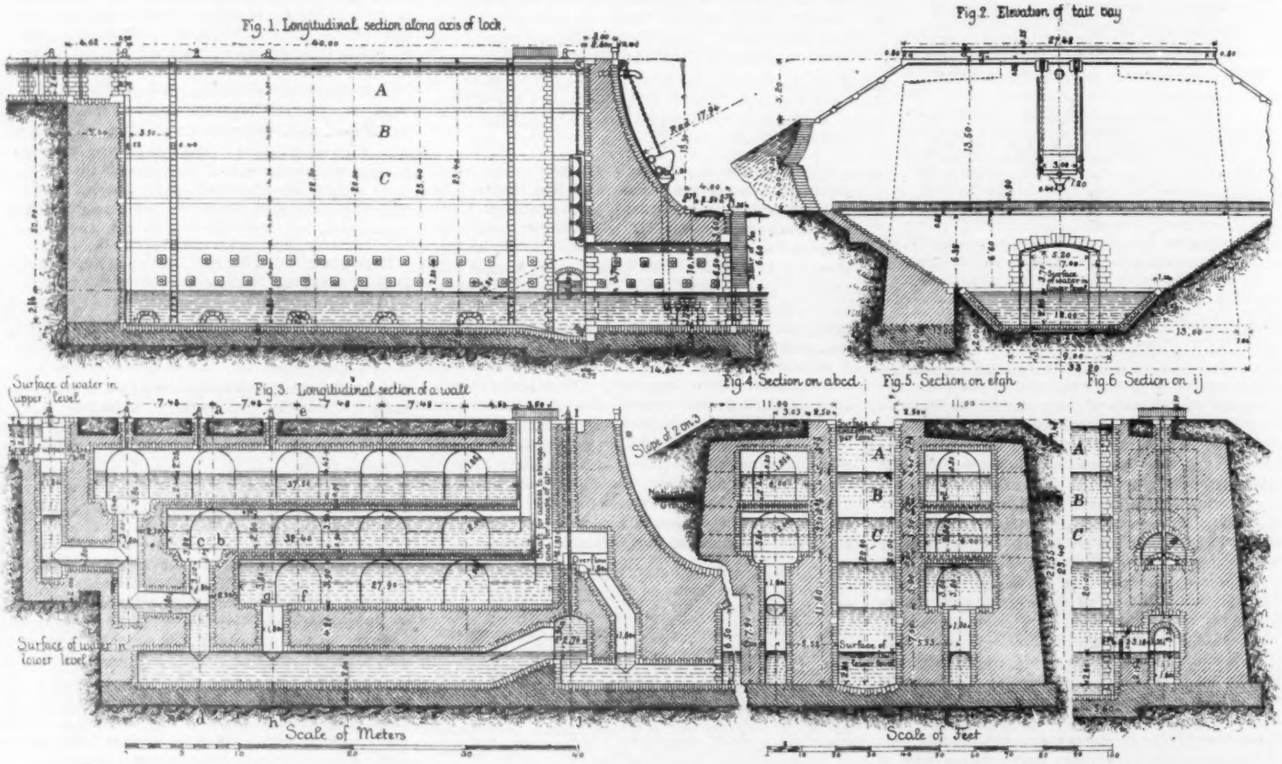


Fig. 1. Longitudinal section along axis of lock.
Fig. 2. Elevation of tail bay
Fig. 3. Longitudinal section of a wall
Fig. 4. Section on abcd.
Fig. 5. Section on efgh
Fig. 6. Section on ij
Surface of water in upper level
Surface of water in lower level
Scale of 2m.3
Scale of Meters
Scale of Feet

PROJECT FOR A LOCK OF 20 METERS LIFT.

Mr. FONTAINE, chief engineer of the Ponts et Chaussées, has just devised a project for a lock of very high lift, namely 20 m., which is well worth describing. The useful length of the lock chamber with 20 m. lift, is 38 m. 50, and its width is 5 m. 20, these dimensions being conformable to the type fixed for main lines of navigation under the law of 1879.

The upper bay is like that of ordinary locks. The inlets to the wells for the valves, by which the lock chamber is filled, are placed in the wing walls. The lift wall is 20m.20 in height and 5m. in thickness. Its down stream face is in plan an arc of a circle. In each wall are placed the aqueduct and storage basins, to be mentioned further on, the object of which is to provide for the operations of filling and emptying the lock chambers. The aqueducts and storage basins in each lock wall are independent of each other.

At a level with the floor of the lock chamber a longitudinal waterway is placed inside of each wall. It opens into the chamber by means of five sluices placed below the level of the bottom of the most deeply laden boats. The water flows through these openings from the lock to the lower level of the canal in emptying the former, and from the upper level into the chamber during the operation of filling it. The water rises or falls in the lock, even at great speed, without making any trouble, without any eddies, very regularly, and without any motion so violent as to cause the slightest harm to the boats. This arrangement is taken from the locks of the Central canal where it has given good results.

The highest points of the floor of the lock are 2m.80 below the normal level of the lower pool. In this way is obtained an important section for the flow of water beneath the bottom of the most heavily laden boats, of which the draft does not exceed 2 m.

The tail bay differs entirely from that of ordinary locks, being formed, in this case, of a wall built across the lower end of the chamber and forming a dam. Through it is an opening, arched overhead, by means of which boats pass from the lock to the lower level of the canal. The springing lines of the arch are 3m.70 above the surface of the water in the lower level. The arched passage way, which is 5m.20 wide at the up-stream face of the dam, widens gradually toward the lower face until a width of 7 m. is reached, this being done to facilitate the entry of boats into the lock. Besides supporting the wall, the arch carries a roadway, 4 m. in width, for crossing the canal.

The up-stream face of the wall is vertical; the cross section of the down stream face is curved; its thickness diminishes from 8 m 90, at the base to 3 m. at the top. The lower gate is similar to a vertically raised flat valve. It is formed of a rectangular metallic panel about 7 m. wide by 8 m. 50 high. It is manœuvered by means of two chains rising straight up from each end. These, after crossing two pairs of chain wheels, are attached to a variable counter poise and bucket which rolls on the down-stream face of the wall of the dam. The wheel pulleys on the up-stream side of the dam are independent of each other in their motion; those on the down stream side, on the contrary, are shrunk on a common shaft. In this way the rising of the gate in a truly vertical direction is assured. The shaft carries a band brake, by means of which the motion of the gate is controlled.

Alongside of the lever which controls the brake is placed the key of a stop cock through which water is let from the upper level into the counterpoise. This last is divided into three compartments. In the two outside ones is placed cast iron ballast which very nearly balances the gate when it is at the bottom. The central compartment can hold from a thousand to fifteen hundred kilogrammes of water, a load which is sufficient to move the gate when the brake is released.

In order to obtain motion in the opposite direction, all that is necessary to do is to let go the gate, to open the valve in the bottom of the water compartment, which allows the water counterpoise to escape and, thus, the gate to descend.

The counterpoise is guided by two rails fastened to the downstream side of the wall. The gate is also guided in its vertical travel by two rails on which run two pairs of wheels. The joint between the gate and the wall, to close the lock, is obtained by the metallic frame of the gate bearing on the wooden frame permanently attached to the wall, the downstream face of the gate being beveled so that it bears firmly against the wooden frame as it goes down. The gate is made of galvanized iron; its weight is about 25 tons. It includes an iron frame of I iron between two vertical sides to which the horizontal beams are riveted. Semi-cylindrical sheet iron panels are fastened to these beams and form a water-tight wall. A double covering insures the stiffness of the whole. The time required to raise or lower the gate is estimated at less than one minute.

The arrangement of the gate which we have just described is marked as being especially interesting and advantageous. By its means no moving part remains constantly in the water, as is the case with any gate which has a lateral motion or one of rotation. Inspection and perfect maintenance of all parts of the gate are easy and can be had at all times. Finally its vertical movement allows the length, and consequently the volume of the lock chamber to be sensibly reduced, which is an important advantage on account of the large quantity of water required for a lockage.

The great consumption of water in high lift locks is one of the disadvantages which have heretofore militated against their use. As a matter of fact (setting aside the displacement of water caused by the boat), a lockage causes the expenditure of a volume of water equal to that of the lock chamber included between the levels of the two pools, this expenditure being the greater as the difference of

level is greater. The 20 m. lock, which we are now describing, has a chamber of 4,452 cu. m. capacity If no arrangement were made for reducing the expenditure of water the consumption would be very great and might cause prejudicial movements in the adjusting levels and might be far greater than the resources of the canal could supply.

On the other hand, if special arrangements were not adopted for causing this great volume of water to flow rapidly, the length of the lockage would be greatly increased and the carrying capacity of the canal would be correspondingly diminished, hence the openings must be large. For these reasons Mr. FONTAINE has provided for aqueducts of large section and storage basins have been added.

There are three storage basins on each side, their useful capacity is about 450 cu. m. each, equal to one-half of the volume of the lock chamber included between two horizontal planes 4 m. apart. They are formed of arched chambers, their floors are set 4 m. one above the other, and the upper basin is placed at such a level that being filled with a sheet of water 4 m. in thickness counted from the level of water in the upper pool, there still remains a difference of level of 0m.30 between the levels in the chamber and this basin. Communication may be had between the storage basins and the upper pool or the lock chamber at will.

Each basin of them has an overflow which prevents the level of the water from rising beyond a point which it should not pass, and an air shaft which prevents the air inside the basin from becoming either too much compressed, or too much rarefied. Furthermore, there is an escape channel which opens into the lower pool of the canal.

The aqueducts have a cross section of about $2m^2.50$. They are provided with balanced cylindrical valves either double or single acting, according to circumstances, of 1m.70 interior diameter. It may be interesting to give a few details of these valves.

A valve includes a fixed and a movable part. The fixed part is of cast iron; it is composed: First, of a circular seat bedded and fastened in the masonry with three bracket shaped uprights, connected by a crown at the top; second, of a hollow cylinder, fastened to the crown, in which a valve rises in order to be opened; third, of a cover bolted on this cylinder and surmounted by a pipe for the passage of the manœuvering rod and the movement of air. The movable part, or valve proper, is a cylinder 1m.70 in diameter and 0m.511 high. It is of sheet iron 4m. thick, the upper edge being riveted to a cast iron crown with arms and a hub, to which the manœuvering rod is fastened, the lower edge being riveted to an angle iron. The sheet iron is re-enforced on the inside, midway of its height, by a small T iron. The horizontal flange of the lower angle iron is slotted at the position of the three uprights so as to guide the valve and to prevent any motion of rotation. The tightness of the valve thus constructed is obtained in the case of outside pressure at the bottom by an india rubber cushion set in a groove of the seat on which the angle iron rests; at the top, by a leather band held firmly against the crown of the movable part by the pressure of the water. Tightness is obtained against inside pressure: at the bottom by the same india rubber cushion; at the top by a band of leather fastened to the crown of the movable part and held firmly against the fixed cylinder by the pressure of the water. The double acting valves have both of these arrangements attached.

These valves offer the following special advantages: When they are well constructed, that is to say well balanced, the force required to raise them is reduced to their mere weight; the whole section of the circular orifice of the seat is utilized by merely raising the valve a height equal to one-half of its radius; the head is thus stronger than on an ordinary plane valve in a vertical wall and the same size of opening gives a greater discharge. All these advantages are essential for the heavy pressures and the great discharges involved in the aqueduct system of a high lift lock.

Lockage.—The preceding explanations enable us to understand the manœuvering required in making the lockage. If the lock chamber and the basins are empty, the chamber is filled by the two up-stream valves, the two down stream valves and those of the basins are closed. This operation accomplished, the emptying is effected by letting the water of the three upper layers, *A*, *B*, *C* (plate), of 4 m. in depth, nto the six basins, namely: The layer *A*, into the basins *a* and *a'*. The layer *B*, into the basins *b* and *b'*. The layer *C*, into the basins *c* and *c'*. The water of the two lower layers *D* and *E* ialone is run into the lower level.

For the next lockage the water from the basins is first let into the lock chamber, beginning, it is of course understood, by the lower basins, each couple of symmetrical reservoirs working together. To complete the filling of a lock chamber it is only necessary to draw from the upper level the volume represented by the two layers *A* and *B*. In this way ⅗ of the cube of the amount of water required is economized, and the consumption is in round numbers $1,800m^3$ for each lockage instead of 4,452, which would be required without the storage basins.

Mr. FONTAINE estimates, from calculations which he has made on this subject, that in spite of the complication caused in the manœuvering by the number of valves and the slowness of the flow of water resulting from the fact that the use of the storage basins reduces the head, the filling or emptying of the chamber will not require more than 10 minutes, and that in this way the total duration of the lockage will not exceed 17 to 20 minutes, that is to say, it will remain very nearly the same as with the ordinary locks of two to three metres lift. Mr. FONTAINE concludes, in these calculations, that the service of the lock will be fully met by means of two lock keepers only.

It is well to remark in this connection that this system of locks involves, as has already been said, an eminently easy entrance for the boats; furthermore, the adoption of very low sluices spread over the entire length of the lock does away with violent eddies and obviates the necessity of tying up the boats in the chamber. Finally, funicular traction is provided to hasten the entrance and exit of the boats through the arched passage. The motive force required to work the traction cable would be furnished by a small turbine of about 10 HP., driven by the fall of a certain volume of water from the upper to the lower level. Such is a necessarily brief description of the lock of 20 m. lift presented by Mr. FONTAINE.

To reduce the expenditure of water in a lockage is an improvement which has been long sought, and of which the solution has not yet been realized in a way to be practicable for ordinary locks. Mr FONTAINE takes up again, and rightly, the already known system of superposed storage basins. This process, which at first glance is very seductive, and is here thoroughly in its place, cannot be realized in practice in locks of small lift, because the diminution in the height of head involves a notable reduction in the velocity of the water, and the duration of a lockage is lengthened. This is an impediment to navigation, and lessens the carrying capacity of the canal. This disadvantage is reduced in locks of high lift where a sufficient difference of level can be maintained between the successive storage basins and the lock chamber, and a proper velocity of flow be preserved for the in-coming water.

The Comparative Merits of Various Systems of Car Lighting.

X.

OIL-BURNING LAMPS

Notwithstanding the advances which have been made in lighting by gas and electricity, kerosene, or some form of petroleum product is still the illuminant used in the great majority of the households of the country. So in the railway service, out of over 30,000 cars now running on passenger trains in the United States probably at least 27,000 are lit by oil lamps. In foreign countries rape seed oil, colza oil and some others of vegetable origin are largely employed. The report on car lighting presented at the International Railway Congress, held at Milan in September, 1887, had the following concerning them:

Rape seed oil is more commonly used than any other material for lighting in Europe. The following are its principal disadvantages: It is irregular; it hardens under extreme cold [European cars not being heated]; it oozes out into the globe and obstructs the light; or drips to the floor and gives forth a nauseous odor. The refilling, cleaning, replacing the globes and wicks and the difficulty of controlling the consumption of oil are also disadvantages Two styles of burners are used, flat and round. Flat burners are more simple in construction, easy to light and clean, require no chimney and are inexpensive. The light is poor, and insufficient air is furnished to the flame; the focus is too high in the lamp. Part of the oil is distilled into the globe. The wick is rapidly carbonized and the lamp burns well only two or three hours. The round burners give a superior light, as the combustion is more perfect and the flame whiter. For the first 12 hours they remain very constant. It is said, however, that they drip 2 to 3 grams per hour.

From other sources we know well that the defects of the vegetable oils as illuminants are not overdrawn in the above. An American traveler in France a few years ago wrote:

The car lamps (which burn vegetable or animal oil) are removable and are made to a standard size. There is an opening in the roof to receive them; and before a train starts on its trip a man will be seen walking along the roofs taking out the lamps, passing them down to a man on the platform and replacing them by others that are filled. They are also lighted and manipulated from the roof, and, though they may leak or smoke, the passengers can do nothing with them. It therefore frequently happens that a lamp will leak until the glass beneath the burner is covered with oil, and the flame will be smoking until the light of the car becomes so dim that the passengers can scarcely distinguish each other.

The reason for the use of these oils abroad is partly the high price of kerosene, due to cost of importation, duties, etc., and partly the prejudice against it on account of its supposed danger. These reasons do not exist here. The cost of vegetable oils is far in excess of the cost of the mineral oils used for car lighting; and, as seen above, the vegetable oils are by no means satisfactory illuminants. The question of danger we shall discuss more fully later; but we may say now that the chief danger from oil lamps arises from the spilling of oil in case of an accident; and this danger is practically the same with vegetable oils as with mineral oils.

Concerning the use of mineral oils for car lighting we extract the following from the paper by Mr. GEO. GIBBS, read before the Western Railway Club last spring (ENGINEERING NEWS, March 7, 1891.)

The grade of oil used until within the past 10 years for car illumination would correspond to the low fire test oil now used for household purposes, gravity about 50°, firing at 150° Fahr. and giving off inflammable vapor at 110°. The unsafe quality of this oil for the purpose was conceded and the invention of improved processes of oil refining and improved burners made possible the use of a heavy, high test oil, so that it is improbable that any of the light oil is in use at the present day. This heavy oil, called "mineral seal," ranges from 36° to 40° in gravity and has a fire test of 300° Fahr.; no inflammable vapor being given off below 250°.

The old oil was undoubtedly highly dangerous, it being possible from improper attention to have it at the temperature of vaporization in the lamp pot; thus a jar, current of air, or defect in the lamp would cause communication of the flame with the accumulated vapor, and explosion would ensue. But the nature of the oil used for car lighting to-day is not popularly understood, many imagining it to be the household quality of kerosene; it is, in fact, totally different, being a heavy oil of difficult inflammability. It may be heated beyond the temperature of boiling water without giving off vapor, and will consequently not ignite in bulk below this point. The flame in the lamp is very sensitive to draft or jar; in fact, it seems impossible for a fire to originate from the light in case of collision, as tearing a lamp from its fastenings would without fail, I believe, extinguish it.

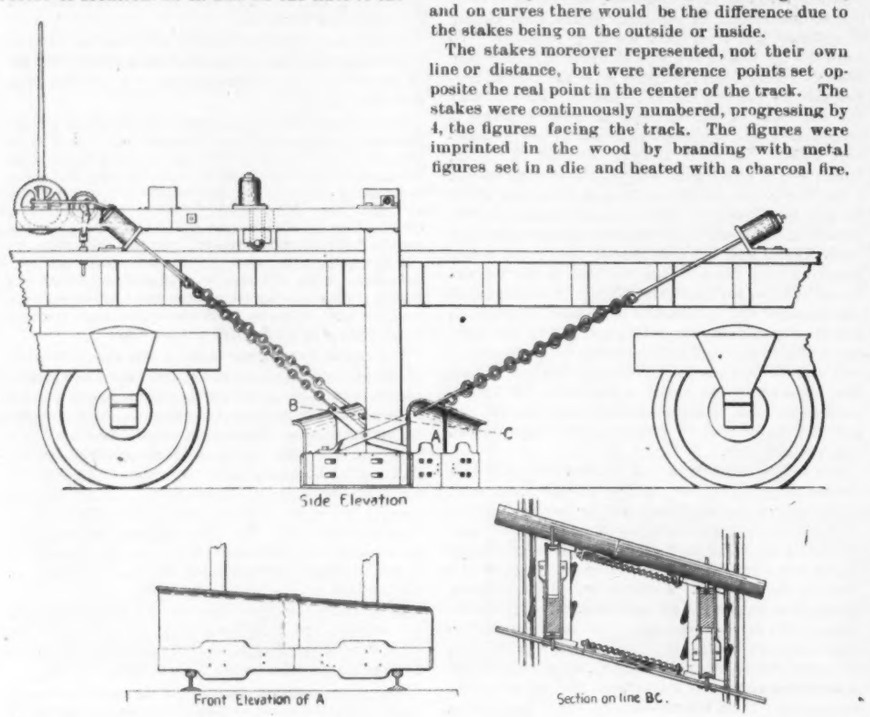
Whether the use of oil of 300° test in place of the common 150° kerosene is universal in railway car lighting at the present time, we cannot pretend to say. Certainly on all railways which make any pretense of keeping up with the times, this change has been made; and indeed the laws of many States require the use of 300° oil on passenger cars, but there may still be a few local roads, which, through ignorance, are still using ordinary kerosene in their car lamps. The difference in price being so low, however, only a cent or two per gallon, the only reason for using oil of low test in railway car lamps at the present time must be ignorance, pure and simple, since with any decently good car lamp the high test oil burns almost as satisfactorily as the 150° oil.

(To be continued.)

ALUMINUM AS A FLASH LIGHT, for photographic purposes, is proposed. It is said that a mixture of powdered aluminum and chlorate of potash gives a brilliant flash without the smoke produced by magnesium.

The Nevens Flange Scraper.

We illustrate in the accompanying cuts a new flange scraper designed by Mr. GEORGE NEVENS, of Brunswick, Me., a roadmaster on the Maine Central R. R. This scraper has now been in use on the Maine Central R. R. for three years and has given general satisfaction. It has also been used on the Concord & Montreal R. R. and on the lines of the Delaware & Hudson Canal Co., and is being introduced on several other railways.



A NEW FLANGE SCRAPER.

It will be seen from the figures that the device consists in general of a double-bladed scraper, which sits diagonally across the track, and is connected with a system of levers on the car floor by which it is operated. Each blade of the scraper consists of a mold board, so curved as to throw the snow well away from the track, and a steel knife for cutting the snow and ice. The knife blades cut even with the tops of the rails, 16 ins. broader than gage and also cut a groove 2½ ins. deep and 15 ins. wide inside of each rail. The mould boards and knives consist of two parts, separated in the middle, and provided with a connecting sleeve and spring, which allow the parts to slide upon each other, or "jack knife" together, in case the scraper hits an obstruction, thus preventing the spreading of the rails.

It can be easily operated by one man and can be run at the rate of 30 or 35 miles per hour. The scraper being double-bladed it can be run in both directions without turning the car.

Railway Surveys and Resurveys.

BY HOSEA PAUL.

(*Continued from p. 241.*)

A resurvey of some 600 miles of railway has been made within the past four years, and as the writer speaks from personal knowledge, a description of the same will be pertinent as giving the results of actual experience.

Measurement and Stationing.—A steel tape 200 ft. long was used with ordinary marking pins. A pot of white paint was carried, and in the inside of the rail, opposite every station of 100 ft., a stripe of paint about 3 ins. wide was placed, mainly for use during the resurvey. At every fourth station, on the left hand side, a stake was driven 5 ft. from the rail. These stakes were of sound oak, sawed and pointed, 3 ins. square and about 24 ins. long. The distance was transferred from the real point at the center to the parallel line outside by a large wooden triangle and pointer made of light strips of wood framed together, and set along the edge of the rail. The stakes were not necessarily 400 ft. apart, first because care was not taken to center them or to check their position by ordinates while being driven, and on curves there would be the difference due to the stakes being on the outside or inside.

The stakes moreover represented, not their own line or distance, but were reference points set opposite the real point in the center of the track. The stakes were continuously numbered, progressing by 4, the figures facing the track. The figures were imprinted in the wood by branding with metal figures set in a die and heated with a charcoal fire. This branding was usually performed daily. The stakes were driven rather more than half way, leaving about 8 or 10 ins. above ground.

At every mile a special post was set. These had the top beveled, were planed and painted, and set diagonally with the track. They were not numbered, but mileage boards figured from each direction were placed on the nearest telegraph pole, so as to be easily read from the trains. The stakes were shipped to the nearest stations, and sub-delivery made by an ordinary hand car with which the party was provided. This staking party also noted corporation, township and county lines, being put to this extra trouble mainly by the desire for immediate information.

The leveling party next traversed the line. Sea-level elevations were obtained from fairly good authority, and the levels run with ordinary instruments. The standard length of sight was 300 ft., which was easily obtained by the paint spots and stakes. This uniformity of back and foresights, of course, eliminated the errors due to imperfect adjustments. And the track being nearly level, there was little occasion of using extended rods. The bench marks consisted of, in addition, those afforded by bridges and buildings, of spikes driven into telegraph poles, and at occasional intervals rail ends were imbedded vertically. Check levels were kept up closely, the party going back every few miles to make them. The crossings of other railroads were particularly noted for comparison with such elevations as they might have. This party noted all bridges and openings, describing them fully, and also took with a hand level topography on each side, usually some what beyond the slopes, so that a fairly accurate representation of the original surface would appear in the profile, and other details, useful in case of change of grade, the putting in of sidings, etc., could either be found in the profile or by reference to the notes.

The transit party was the third and last. At the outset of the work this party also attended to the staking, but after a couple of months the work was divided. The party was provided with tracings of township maps, town plots, etc., and in passing along were expected to identify and note all lines of sections and their subdivisions; especially at section corners and quarter posts inquiry and search were made for stone monuments, the idea being to use such monuments when convenient, but not ordinarily regarding them as indispensable. In making locations the plus was taken from the stations established by the staking party. Angles were observed to all lines or the visible marks of them (fences, etc.). The angles to a line of rail fence, though noted in minutes, might vary a much larger fraction of a degree from the line that might be established by a surveyor.

A lookout was kept along tangents for slight angles, and the deflections set down. On curves, which were as a rule somewhat flattened at the ends, care was taken to set up the transit somewhat on the tangent. The first deflection noted might be very slight and the observation would continue to a point somewhat beyond the curve on the terminal tangent. No attempt was made to locate the ends of the curve except in this way, the idea being to get the total deflection and the actual present position of the track without reference to its theoretical location. The side tracks were noted first by station and plus at points of switch and point of frog, and where nearly parallel their course was noted by the distance from the main track. When the line of divergence was considerable, as in spurs to factories off the line, Y tracks, and the lines of other railroads, a special measurement and traverse was usually necessary. On Y, connecting and transfer tracks inquiry was made as to the ownership of such tracks, information being personal or traditional on the part of the local trackman, rather than a matter of record.

Each of these field parties consisted of three men, an engineer in charge, who was also transitman, leveler, etc., in turn; a rodman qualified to use the instruments somewhat and a tapeman or stake driver, as might be required.

Each party was supplied with an ordinary hand car, and made considerable use of the trains for back travel, shipment of baggage, supplies, and for communicating with the general office.

Field Notes.—With the mass of information covering so many points system and clearness in the field notes were a prime necessity. No detailed notes were kept by the staking party. The level notes of main track elevations were in separate books from the side topographical notes. The transit or alignment notes were on a somewhat larger page than ordinarily used. The stations, pluses and alinement being entered on the left hand page, two or more lines being left for each station. On the right hand page the intersecting lines were drawn with a ruler in as near their actual direction as might be without a scale. Sometimes they were taken somewhat roughly in the field on scratch books, and more carefully entered up at night on the regular field books. Bridges and buildings had books especially devoted to them, the entries usually being made by the assistant, while the transitman was engaged in copying records or other duty.

Transcripts of Plots.—In advance of the work of the transit party, so as to be available for their use, each country-seat was visited, and tracings made of the official recorded plots of the various towns. In addition to this, information in regard to lines was sought from local surveyors, city engineers, etc. Care was taken, especially in case of official plots, to make the copies complete, very frequently including data in regard to lots some distance from the track, and to transcribe descriptions, dedications, dates, etc., so fully as to save the necessity of re-examination. They were made with ink upon tracing linen, and after being used by the transit party were sorted over and arranged with regard to their position in the line, and then pasted flat into large scrapbooks for convenience of future reference.

The plots or plans were made on best quality of white drawing paper, cut into sheets, mounted on muslin and pressed flat. The sheets were 18 × 42 ins., with a border line drawn 1½ ins. from the margin. The center line of the track was placed as near centrally in the sheet as might be; in case of curvature it was usually plotted on another sheet

so as to determine its position. The line was plotted 200 ft. to the inch; the villages and towns somewhat in outline, as they were afterward repeated with greater detail on a scale of 50 ft. to the inch.

The 200-ft. scale would therefore take in about 76 stations, or nearly 1¼ miles; the 50-ft. scale somewhat less than 19 stations, where the central line was a tangent, and therefore midway and parallel to the sides of the sheet; where the line was somewhat curved more stations might be shown, but the repetitions at the end of the sheets to show connections with other sheets would also be increased.

A village of any size would require more than one sheet, hence the convenience of the 200-ft. scale, which would serve as a sort of condensed abstract or graphic index to the fuller details.

The center line was drawn in red ink, each station being indicated by cross marks. On the 200-ft. scale every fifth station was figured, on the 50-ft. scale maps every station was so marked. On these station plans both rails were shown in blue, except for foreign roads, which were drawn with brown ink. Mile posts were shown with a circle inclosing the number. In general, all distances were put down in black along dotted red lines extending outward from the particular point noted, as nearly at right angles as might be. Small points, such as posts of various kinds, were named on such lines and indicated by a small dot within a circle. Stone monuments were shown by a dot within a square. Cross measurements, except as clearly indicated by arrows, referred to the center of the main track. Section lines were drawn somewhat heavy, a long dash and three short ones, township and county lines being shaded yellow on left hand and green on the right. The half mile lines were shown by a lighter line, one long dash and one short one; quarter mile lines by short dashes; street, city lot lines, etc., with full lines, and lines of occupation, fences, etc., desirable to note, but whose relation to other lines was doubtful or not clearly understood, were shown in yellow. Other objects and structures were drawn in plan. The company's land was indicated by a wash of red, brick buildings were tinted a somewhat deeper shade of the same color, and frame structures were tinted yellow. Opposite to each tract of land, about midway toward the margin, was an abstract of the contents of the particular instrument showing the company's title, with names, descriptions, dates, volume and page of county (and company), records, etc., somewhat abbreviated, but intended to be so sufficiently complete that reference to the original papers would rarely be necessary. Such original deeds, certified copies of condemnatien proceedings, etc., which were arranged by townships, counties, etc., were then deposited in tin file boxes in a fireproof vault.

At the lower left hand corner along the border line the name of the surveyor, date, number of field-book and name of draftsman and date of executing the map were set down. In the lower right hand corner a plain running title was put in, giving station, etc. The number of the sheet was placed in the corner outside.

Some 20 or 30 sheets were bound together, the counties being kept separate as nearly as might be, and the first map in the volume was in the form of an index. This was drawn on a scale of 2,000 ft. to the inch for the purpose of giving a general and comprehensive skeleton rather than details, and along the center line the portion covered by each of the several sheets was marked off, making the index a graphic rather than a tabular or alphabetical one. It also served as a title page.

The sheets were bound along the upper edge, the book thus opening sidewise, and the sheets were attached by stubs or guards of heavy muslin to a spring back so as to open freely and flat.

The style of lettering, while not ornate, was regular and methodical. Abstracts of deeds, etc., were put on in a condensed slanting letter, founded somewhat on lower case roman, but with bold stems without shading or fine lines. For the names of tations, etc., roman capitals were used.

(To be continued.)

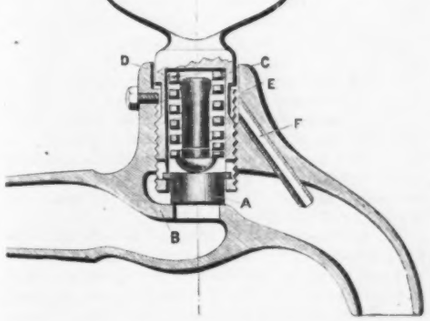
BEACON HILL, in Boston, is to be explored by diamond drills in the interest of rapid transit in that city.

An Indestructible Faucet.

We show herewith a sectional view of a novel water faucet, the inventor of which is no less a personage than Sir WILLIAM THOMSON, President of the Royal Society of Great Britain. Its design is certainly ingenious, and we understand it is giving excellent satisfaction in service.

The two most troublesome features of ordinary faucets or cocks are the valve and the stuffing box. The valve is generally made of some fibrous material, or some composition of rubber, and it sooner or later wears out and has to be replaced, which in the average household necessitates a visit from the plumber. The stuffing box, however, is really a worse defect. While the faucet is new it is often packed so tightly that considerable force is required to shut the flow entirely off, and careless servants will not take this trouble. At a later stage, when the packing is worn, a small fountain appears around the valve stem whenever the faucet is opened.

It is quite true that repacking stuffing boxes and replacing valves is a small matter, but the plumber's bill for the work is not always so small; and the average householder will let his faucets go leaky for months or years before he will call in a plumber to pack them.



An Indestructible Faucet.

A Metal Valve. B, Metal Seat. C, Spring (non-corrosive). D, Stop. E, Annular Space. F, Eduction Tube.

It was to avoid these failings of the ordinary faucet and make a faucet which should need no attention from the time it was put into use until some time still too far in the future to be foretold, that inventor designed this faucet.

The faucet is made entirely of metal. A vertical section is shown in the accompanying engraving. The metall valve *A* on reaching the seat *B*, also of metal, is not suddenly arrested and compelled to seat itself hap-hazard, but continues to turn on its seat as the handle is turned, receiving meanwhile a gradually increasing pressure from the spring *C*, centrally applied by the rounded head of the stop *D*. The valve is thus rubbed upon its seat at every opening and closing, and both valve and seat acquire and maintain a perfect fit and finish. The manufacturers state that no material wear is shown on the valve and seat even after it has been opened and closed as much as would occur in many years' service. The spiral spring has been subjected to compression 700,000 times without showing any loss in power. The cock has been opened and closed by machinery with water flowing 540,000 times, or the equivalent of 50 years' use at 30 times a day. At the end of the test the valve was still tight.

The method adopted to avoid the use of the ordinary stuffing box is very ingenious. An "eduction tube" projects into the faucet opening and sucks out any water which may collect in the chamber around the valve stem through leakage around the screw when the valve is opened. This device is claimed to be thoroughly effective.

The faucet is made of gun metal, and is sold at from 3 shillings to 6 shillings 6 pence ($.72 to $1.56) according to style and size. It is made by the Palatine Engineering Co., of 10 Blackstock st., Liverpool, England, which controls also the American patent on the device. The company is better known to American engineers under its old title of the Waste Water Meter Co., under which name it has for many years handled the waste preventing detector invented by MR. G. F. DEACON, the engineer of the Liverpool Water-Works.

Concerning the Kirkaldy System of Testing Materia's.

For the following review of "Strength and Properties of Materials, with Description of the System of Testing," by Mr. WM. G. KIRKALDY, we are indebted to Mr. ALFRED E. HUNT, C. E., of the Pittsburg Testing Laboratory. The criticism and opinions here expressed concerning this work, coming as they do from an American authority in the system, methods and results discussed by Mr. KIRKALDY, make this contribution of much more value and worthy of more prominence than an ordinary book review, and we present it accordingly. The work of Mr. KIRKALDY is a record of 11,786 tests made at the famous Testing and Experimenting Works of David Kirkaldy & Son, in London, and include a full description of the methods of testing and a valuable series of conclusions as deduced from these experiments regarding the strength and properties of materials. Of the contents Mr. HUNT says:

The record of the tests, placed in clear and distinct type, and with clear reports of same, form a very valuable record of engineering data. Added to these are very many valuable suggestions and generalizations which are the result of the ripe experience of David Kirkaldy & Son in testing, which make the book one of the most valuable additions to engineering science that has been published in the last decade. The index of the volume is especially complete and full, and adds much to its value as a book of reference. The printing of the tables is especially commendable in system, the heads reading from the top toward the bottom of the page in all cases, rather than the reverse, which often occasions the book to be held upside down in order to be read. The arrangement of the type throughout the work is excellent, the more important figures being placed in heavy type in his reports, so that they may be more readily grasped among the mass of data. "Facts, not opinions," is the elder KIRKALDY'S motto, and comes out throughout the entire work. Every American engineer who can do so should visit KIRKALDY'S works, London, as one of the instructive points of the district. He has adopted the system of saving the specimens from the many tests which have been made at the works, in a museum, where they remain, properly labeled, and are themselves an object lesson of great importance. For instance, the record of the tests that the KIRKALDYS have made of steel rails speak plainer than words of the development that has been made within the last 30 years in the manufacture of rails, from the old iron rail to the best forms of steel rails in use to-day.

Articles on "Testing Clauses and Specifications" especially ought to be read by all American engineers, as there are many statements contained which are the result of KIRKALDY'S practical experience, which will be of service to them.

It is to be regretted, however, that Mr. W. G. KIRKALDY has found it advisable, in defense of his father, as he says, to go so much in length in his book regarding misrepresentation, false statements and trickery that he has found in his experience with those who have been his customers and clients in many cases or with those with whom he has had to deal in his work. There is only one portion of it in which we have received equally disagreeable results—that is, in the matter of his complaints about the tests causing delay to the work. In this, the experience of inspectors in America, I believe, corroborates entirely that which KIRKALDY complains of. It seems to be throughout the world a widespread custom of blaming every delay, in filling orders on time, upon the inspectors and those who make the tests. It is certainly a very easy way of getting out of trouble; and it is human nature to put the trouble on some one's else shoulders instead of

one's own, if possible. But regarding the remainder of the experience which Mr. KIRKALDY goes so fully into detail about, as an inspector who has had a very large experience with all of the large structural mills throughout the United States, I am glad to be able to say that there has not been that spirit of endeavoring to avoid honestly carrying out the requirements of specifications among American contractors and mill management that the state of affairs detailed by KIRKALDY would indicate there is in Great Britain; and in the limited experience I have had with foreign contractors, I have been fortunate in not having had such experience as Mr. KIRKALDY complains of with the manufacturers of Great Britain. I am glad to state that the American manufacturers are, as a rule, above these dishonest practices, and that the business honesty and general integrity regarding the filling of specifications is about all that could be asked for. In the few cases where trouble has been found, it has been traced to the action of irresponsible subordinates; and when attention has been called to the facts in the case the principals have been prompt to remedy it by decisive steps, in almost every case resulting in the discharge of the subordinates who have been detected in any deception of the inspectors.

I feel confident that in many of the cases to which KIRKALDY refers, what looks to him to have been willful action on the part of the principals in the matter of deceiving him, was really unintentional on the part of the manufacturers. The maxim that "honesty is the best policy" surely is not so little considered as one would imagine from what Mr. KIRKALDY writes as his experience with English manufacturers.

In this connection, the complaint Mr. KIRKALDY makes of various professional men who stand high in their calling is much to be regretted, and undoubtedly and unfortunately will detract from the favorable reception that the labor and careful scientific statements in the work certainly merit.

KIRKALDY has done much to establish and maintain uniform standards, in not only the methods of making tests, but in recording their results. We, as American engineers, are not only interested to know of it, but believe that he is doing a public service in recording his measurements in pounds per square inch, rather than tons, as is the common practice among English engineers, who still, as KIRKALDY says, "think in tons."

One cannot help but regret that we have not upon this side adopted the 10-in. length, giving the advantages of the metric system for measuring the elongation, rather than the 8-in., which has now become almost the universal practice in America. The 8 in. measurement, to be sure, is very near to the 200-millimetre length upon which the French Admiralty measure extensions; and was first chosen by the British Admiralty as the nearest English unit to this measure. However, as it is not exactly equivalent to the 200-millimetre length, it loses very much of its value as a method of comparison. The objection, besides that of custom already established, that seems at present to be the greatest against the 10-in. length, is that it will require 2 ins. more of waste of bar or plate which is being tested—a matter which is of no small moment in the regular system of making tensile tests. The same argument, however, does not apply to shortening the 8-in. length; for it is found by experience that not only the local errors, but the difference in extension of the specimens at point of fracture cause a very considerable increase of irregularity in the results of percentage of elongation, where the extension is measured in less than 8-in. (as in 6-in. or 4-in.)

The extension of eyebars is very largely now quoted in 10-ft. lengths, although with long bars, besides the extension in 10 ft., the extension in the longest length obtainable in the bar is recorded, also in 1 ft. at point of fracture; but in the requirements of specifications an extension of 10% in a length of 10 ft. is a very common one. To carry out KIRKALDY's method these extensions should be measured upon 100 ins., 200 ins. or 300 ins., rather than upon the exact number of feet, carrying the decimal figure forward in the short specimens to those in full size to better advantage. This arrangement certainly seems to be a good one.

As to the French system of expressing the tensile results in kilograms per square millimetre, most American engineers will agree with the criticism of Mr. KIRKALDY that it is too small an area in connection with the kilogram as a unit of strain.

Mr. KIRKALDY recommends expressing the ultimate strength in terms of the fractured area instead of in terms of the original area, although in his reports he records both results. This system is not carried out at all in American practice, and the writer does not consider it as an advantage to do so, due to the difficulty of correctly measuring the fractured area. It is certainly an advantage to have the terms of the ultimate strength put in relation to the ductility of the specimen, as giving the ultimate strength in terms of the fractured area would do. But in samples of iron especially, where the welds have been opened at the point of fracture, it is practically an impossibility to accurately determine the fractured area, and the same remark applies to steel as well, although not to the same extent. But even with steel fractures, the point of least reduction of area is often not at the point of fracture, and if near the point of fracture, but not exactly at it, shows a very inaccurate result as a measure of the ductility of the specimen.

KIRKALDY's method of obtaining the elastic limit by measuring the increments of extension at regular intervals and determining the point where the increments of extension are not proportionate to the increments of load applied, is certainly a most accurate one. I do not, however, agree with the utter condemnation which Mr. KIRKALDY gives to other methods of obtaining the elastic limit by the drop of the beam or by finding the point where an actual set, discernible to the eye, is obtained. As a matter of fact, the elastic limit is not used as a method of determining the quality of material to any considerable extent among American engineers, as it is found even with the elastic limit accurately determined, it is not a safe factor to use alone, at least for determining the character of iron and steel.

The requirement that the elastic limit shall be 26,000 lbs. per square inch for iron, and at least one-half the ultimate for steel, is the usual one, and rarely are objections made upon this clause, even with the elastic limit determined with the greatest care by the same method as KIRKALDY uses. The system has an objection of adding a very great deal to the time of making tests, which is an important factor in regular mill practice, where it is difficult, even under the present arrangements, to get out the requisite number of tests and keep up with the material manufactured and ready for shipment. With the system suggested by Mr. KIRKALDY, it would be difficult to get the number of tests that are required and have orders shipped with any reasonable degree of promptness. Engineers in this country consider that it is much better to get a larger number of tests to determine with approximate accuracy the tensile strength, elongation, percentage of reduction of area and character of fracture, than it is to obtain fewer tests, which, although they may be very accurately made as to the particular sample, are not at all so likely to represent the material.

Mr. KIRKALDY's system of having his own machine shop and preparing his own specimens whenever possible, is an excellent one. Thus he is better enabled to know just how the material which he tests has been treated, and more exactly as to the conditions under which the tests are made. My experience agrees with that of KIRKALDY, that broken bridge parts or specimens of bursted boilers should be sent intact to be cut up more intelligently at the testing laboratory. Often accurate conclusions cannot be arrived at without this knowledge of just how the specimens were obtained, and just how the specimens were located in relation to the original work.

Mr. KIRKALDY makes a distinction between thrusting and compression strains which is not recognized among American engineers, he making the point that many "thrusting" strains which are grouped together under "compression" among American engineers, are not such; that this is not a correct term in that there is no actual "compression" caused by the strains. His point is that in "compression" strain the material would become *denser* or actually *compressed*, whereas in many a "thrusting" strain there is no such result obtained; he making the statement that "many metals become less dense when subjected to thrusting strains through extending laterally in a greater degree than is due to the shortening of length." This is an interesting point, but is, at the same time, one that has not been recognized by such authorities as RANKINE, who, in "Applied Mechanics," page 274, puts the strains produced by thrusting stress as "squeezing or compression."

KIRKALDY does not use in his testing machine diagrams to record the extensions up to the elastic limit, preferring the system of actually making the measurements. In this it seems to me that he is wrong. The newer forms of automatic diagrams designed to go with the Olsen testing machine give results which certainly are satisfactory, and, as a matter of record, seem to the writer to be more authentic than the system of making the exact measurements at the increments of load, and plotting same.

I do not agree with KIRKALDY's statement that the method of manufacture of material ought not to be specified by engineers requiring structural material. As an illustration, take the case of car spring steel. No one has yet been able to obtain as good results from either the Bessemer or open hearth process, in uniform work, as from steel made by the crucible process. At the same time, very many excellent spring bars, as shown by their test, have been produced by both the Bessemer and the open hearth processes. However, with the record as large against the uniform success of car spring steel made by either the Bessemer or open hearth processes, I think that engineers are perfectly correct in specifying against it, and requiring steel for such purpose to be made by the crucible process. Another illustration: Boiler plate has not been made uniformly and successfully by the Bessemer process in America. I should consider it advisable for an engineer in drawing up a specification for boiler steel to specify that open hearth steel, rather than Bessemer or crucible steel, be used.

I do not agree with the position of Mr. KIRKALDY in objecting to a maximum as well as a minimum for tensile strength of structural material; he thinking that if the steel has answered ductility requirements, and is rejected on higher ultimate strength, it would be because it was "too good"; thinking that all that would be needed is the requirement for the contraction of area at fracture in order to cover the higher ultimate strength; he saying: "Surely it will be granted that if it were practicable to make steel of higher grade yet with a high ductility, such material should be preferred rather than condemned.' In this Mr. KIRKALDY does not recognize the fact that with the higher tensile strength necessarily goes an element of hardness, even though the ductility be good, which would prevent the steel being easily punched and otherwise worked in fabrication, and that the steel of the higher tensile strength could not be so safely used after being punched without being reamed, and in fact in most cases referred to by Mr. KIRKALDY, in American practice would require the holes being drilled rather than being punched at all, even though the ductility were up to the requirement of the lower tensile strength steel.

Again I do not agree with the criticism which Mr. KIRKALDY makes against requiring both the percentages of reduction of area and of extension; he stating: "If they are synonymous, or in correct relation, then it is not necessary to detail both; whereas, if the amounts are antagonistic, or do not tally exactly, the specification cannot be enforced, as the manufacturer might justly point out that he had complied with one of the requirements and if the other did not tally it was not the fault of his material." This argument of the manufacturer would not be a correct one. I have often had samples of steel which would have given over 20% elongation in 10 in. in which the reduction of area was way below that which would ordinarily be required and where the fracture showed crystalline and burned steel. While, of course, in ordinary samples the facts would bear out the position taken by Mr. KIRKALDY, at the same time there are many cases where the failure of ductility of the metal is only shown by one of the factors of either the elongation or reduction of area.

It is the common American practice, and the

author thinks it is a good one, especially for steel, to have the requirement for both the elongation and the reduction of area—the greater weight being placed upon the requirement for elongation; but, at the same time, the data with reference to the reduction of area, and especially with reference to the character of fracture is noted and taken into consideration in the acceptance or rejection of material.

Mr. KIRKALDY mentions a new term regarding tests under shearing stress in speaking of "detrusion," as the amount the dies have moved across or out of line before the final shear. It is the amount of distortion, without actual rupture, that a specimen will take to which Mr. KIRKALDY has given this term.

The "bulging test" described by Mr. KIRKALDY as the amount of stress required to force a specimen disc of 12 in. in diameter through an aperture of 10-in. diameter, and the amount of bulge in the plate produced under any given stress, is a practical test which could be more often used to advantage in this country than at present.

I do not agree with Mr. KIRKALDY'S recommendation, on page 68 of his book, as to the use of higher grades of steel for rolled beams than that running from 60,000 to 68,000 lbs. per square inch tensile strength. While I agree that the element of brittleness in specimens does not seem to have been obtained, as shown by his results of Dorman, Long & Co.'s beams. At the same time my experience is that, owing to the danger of producing internal strains in the beams, which are liable to cause their fracture without apparent cause, and to the difficulties of getting the higher carbon metal to roll as soundly into beams, without producing more defective ones, I would not advise this higher tensile strength material, even though the rigidity of the beam would be considerably increased by it. The dangers and risks involved to the engineer and the manufacturer in his actually rolling the beam is so much greater that the American practice to day is toward beams of the softer steel of from 55,000 to not over 65,000 lbs. per square inch tensile strength. It is especially important to have the tensile strength lower if punched holes are to be put in the flanges of the beams. In such case, the harder steel spoken of by Mr. KIRKALDY would certainly not be satisfactory.

The results of tests on large wooden columns and beams are worthy of special attention, and, with similar results reported by Prof. GAETANO LANZA, of the Massachusetts Institute of Technology, show that the coefficients for the strength of large wooden beams are very different from those obtained from small selected test specimens.

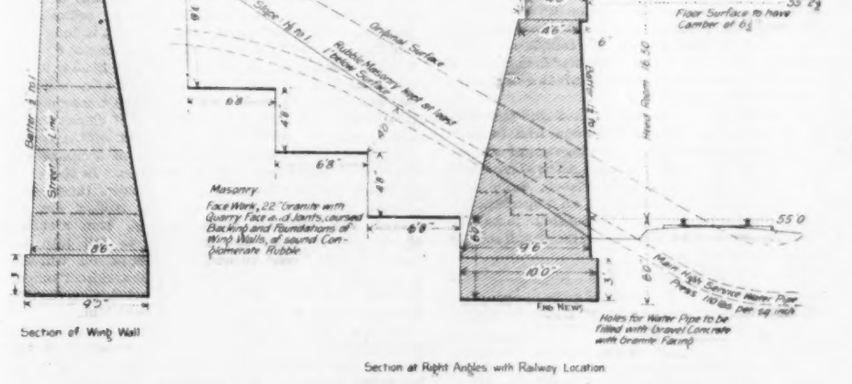
The conclusions which Mr. KIRKALDY arrives at in making his many and varied experiments, on pages 211 and 212 of his work, are most noteworthy; and while many of them are well recognized by American engineers, there are some of them which should receive careful consideration; and taken together with the full and clear reports of the experiments themselves which form a considerable portion of the work, enable the reader to note and study the data in a way that makes the work one of extreme scientific value, and one that every engineer should read and have as a book of reference. For instance, the 41st conclusion, with reference to the shearing strain that steel rivets can be subjected to without actual rupture—being one-fourth less than the tensile strain. The 34th conclusion, that the lateral dimensions of specimens form an important element in comparing either the rate of, or the ultimate, elongations, as Mr. KIRKALDY says, is a circumstance that has hitherto been overlooked. The 61st conclusion, that the specific gravity is found generally to indicate pretty correctly the quality of specimens of iron and steel, is another point that should at least receive careful attention.

The fact that the density of iron is decreased by cold rolling instead of increased, and that the density of some descriptions of iron is also decreased by additional hot rolling in the ordinary way, and that the density of iron is decreased by being drawn down under tensile strain, instead of increased, is data that is not known to all. The subject of magnetization of iron and steel is touched upon in Mr. KIRKALDY'S book, on pages 300 and 301, and brings out data which will be of considerable interest to electrical engineers.

Plate Girder Highway Bridge: Brookline, Mass.

(WITH INSET.)

We present in this issue the plans of a plate girder highway bridge at Brookline, Mass., carrying Dean Road across four tracks of the Boston & Albany R. R. The conditions to be met were a limited depth of bridge, only 2 ft. 7 ins., together with an economical type of structure and a pleasing appearance. The bridge has a skew angle of 75° 24', a clear span of 55 ft. 2½ ins. between the copings of the abutments, and a width of 50 ft. A cross section of one of the abutments and wing walls is shown in Fig. 1. The face work of the masonry is of 22-in. coursed granite with quarry face and joints. The backing and foundations of wing walls are of sound Roxbury conglomerate rubble, kept at least 1 ft below the surface. The rubble masonry is laid in Rosendale cement mortar, composed of 2 parts sand to 1 part cement. The granite facing is laid in 20 to 24-in. courses, the lines of which were not allowed to deviate more than 1½ ins. from the horizontal line, which gives a good bearing surface from end to end. The


Street Gradient 2 per ct
Slope ¼ to 1
Original Surface
Rubble Masonry kept at least 1 Below Surface
Masonry
Face Work, 22" Granite with Quarry Face and Joints, Coursed
Backing and Foundations of Wing Walls, of sound Conglomerate Rubble
Floor Surface to have Camber of 6½
Hand Rail 16.50
Main High Service Water Pipe
Section of Wing Wall
Section at Right Angles with Railway Location

F.G. 1. ABUTMENT AND WING-WALL OF HIGHWAY BRIDGE, BROOKLINE, MASS.

foundation is on hard blue clay, except two or three of the upper steps of the wings, which are on a gravel overlying the clay. The clear headway is 16 ft. 6 ins. The bridge has a roadway 33 ft. wide, and two sidewalks 9 ft. 6 ins. wide.

The contract for the abutments was let in October, 1890, to D. H. Cram, of Boston, at $7.89 per cu. yd. for 1,000 cu. yds. of masonry, including cut work, and 49 cts. per cu. yd. for 900 cu. yds. of excavation. The contract for the bridge was let Feb. 23, 1891, during the dull season among the iron men, to the Springfield Iron Works, of Springfield, Mass., for $3,490, which was about 4 cts. per lb. for the 75,000 lbs. of iron work. The work was very satisfactory. The 200 ft. of fencing is of the Manly & Cooper Co.'s design, and cost $3.10 per ft. in place. The main girders, each weighing 10 tons, and the floor beams, were put in place May 24 by a steam derrick of the patent type owned by D. H. Cram. The total cost of the structure complete, including administration, was about $4,000. It was designed and constructed under Mr. ALEXIS H. FRENCH, Town Engineer, and Mr. JOHN E. CHENEY, of Boston, was consulted in the design for the superstructure. The Assistant Engineer in charge was Mr. HENRY F. BRYANT, to whom we are indebted for the plans and specifications.

The bridge was designed for the usual 100 lbs. per sq. ft. coming on from one end, and the smaller members for a 15-ton Aveling & Porter steam road roller, giving a maximum fibre stress of 12,000 lbs. The superstructure does not offer any particularly novel features, except the method of carrying the water pipe, which is 10 ins. diameter and under about 265 ft. static head. In this there is a departure from the usual method, by placing the pipe in the center of the floor beams at the point of maximum deflection, and also in passing it through these beams rather than over them above the flooring and alongside one of the main girders, the object being to remove every obstruction from view as far as possible. While the design is a success as regards appearance Mr. BRYANT considers that when economy is not extremely essential, it would be preferable to use longitudinal girders spaced about 8 ft. 4 ins. apart, and entirely below the upper planking, giving the floor about 9 ins. camber. This would add about $800 to the cost of the iron work.

The two main girders are about 63 ft. long, 4 ft. 9 ins. deep at the ends and about 6 ft. at the middle with the top chord curved to a radius of 318 ft. A half elevation and a cross section at the middle are given in Fig. 2, which shows clearly the construction of the girder. Each girder weighs 10 tons. The webs are of ⅜-in. plates. The top and bottom chords are 13½ ins. wide, composed of two thicknesses of plate, with angle iron 6 × 6 × ½ in. These girders are 33 ft. 4 ins. apart between the webs, and support five plate cross girders or floor beams, 25 ins. deep, spaced 12 ft. 10 ins. apart. These floor beams have ⅜-in. webs, with top and bottom chords composed of 4 × 4 × ⅝-in. angles, and two 8½ × ⅝-in. plates, 17 ft. 5 ins. and 24 ft. 1 in. long respectively. At the middle of each of these girders is a triangular hole to allow for the passage of a water pipe, and this panel of the web is braced, as shown in Fig. 3. The pipe is carried by two lines of 4 × 6 × ⅝ in. angle irons. The diagonal bracing of the floor beams consists of 3 × 3 × ⅝-in. angles. On the outer side of each main girder are cantilever brackets 9 ft. 4 ins. long to carry the sidewalks. These cantilevers are in line with the floor beams, and their construction is shown in Fig. 4. The outer ends of these brackets are connected by a plate girder fascia beam 1 ft. 9 ins. deep, with webs of ¼-in. plate in five sections, with angle irons 2 × 3 × ¼ in., beveled 45° at the ends, and all rivets ¾-in. diameter with 1⅛-in. heads. One of these beams is shown in Fig. 5.

Each floor beam has riveted to the web 12 angle iron brackets, 3 × 3 × ⅝ in., six on each side of the water pipe, spaced 2 ft. 4 ins. c. to c. Upon these brackets rest 4 × 14-in. hard pine stringers, with a flooring of 2-in. hard pine planks laid transversely and spiked with 6-in. steel wire spikes and 2-in. spruce planking laid diagonally and fastened by 30 penny iron nails. Over the tops of the floor beams the 3-in. planking is replaced by 2-in. hard pine planking. The wall plates are 8 × 12 in. hard pine. These details of the flooring are shown in Fig. 6. The wheel guard is of hard pine 5 × 6 in., faced by an angle iron 3 × 4 × ⅝ in. The sidewalk is of 1½-in. transverse pine planks, fastened by 20-penny steel flooring nails to four lines of spruce stringers 3 × 12 ins., resting on top of the cantilevers. The stringers are bolted together by 1½ in. bolts. The cross section and plan of the general arrangement of the construction of the bridge and flooring are shown in Figs. 7 and 8.

The following details are taken from the specifications:

"Wrought iron bearing plates are to be fox-bolted to the masonry and set in neat Portland cement, the bolts being set to place with the same. The masonry will be dressed to grade by the town.

All roadway stringers are to be of hard pine, and hard pine wall plates are to be placed upon the abutments to support ends of stringers. All sidewalk stringers are to be of spruce, bolted together with ⅝-in. iron bolts and resting upon hard pine wall plates at the abutments. Roadway plank are to be in two courses, the under course to be 3-in. hard pine brought to an even thickness and spiked to stringers with 6-in. steel wire spikes, two spikes to be used at ends of plank, and one spike in each other bearing. Holes for spikes to be bored if required. The upper course of roadway plank is to be 2 ins. thick spruce, planed on one side to an even thickness, laid diagonally, and well secured to the under planking by 30-penny iron nails. Sidewalk plank are to be of hard pine, 1¼ ins. thick and 6 to 8 ins. wide, planed on one side to an even thickness, jointed and well nailed to stringers with 20-penny steel flooring nails set in ¼-in. after driving. The boxing between wheel and foot guards and the main girders is to be of 2-in. white pine, planed on one side and matched. All timber is to be strictly first-class bridge timber, well seasoned, sawed true and out of wind, full size, and free from all defects impairing its strength and durability, and subject to the inspection and acceptance by the engineer.

All rivet holes are to be arranged as shown in the drawings, and are not to exceed the specified size of rivet by more than $^1/_{16}$-in. They are to be accurately spaced and punched, and are to fit so accurately over each other that the intrados shall not vary more than $^1/_{16}$-in. from that of the adjacent hole, and will easily admit of the cold rivet of the specified size. Drifting will not be allowed. Whenever possible, rivets must be driven by machines capable of holding on to the rivet after the upsetting is completed. All rivets are to have neatly finished full hemispherical heads, free from cracks and concentric to the rivet holes; and when driven, must completely fill the hole. Rivets are to be made of the best double refined rivet iron, and all loose or imperfectly driven rivets are to be replaced by sound ones.

All iron work is to be neatly finished and free from ragged or crooked shear cuts; all shape iron to have straight, sound, smooth edges. Top flange plates of main girders to be "universal mill" plates. All wrought iron used in the work must be smooth finished, uniform in quality, tough, fibrous and free from all imperfections. The wrought iron used must have for a minimum an ultimate strength and elastic limit per sq. in. on full section of test piece, as follows:

Material.	Ultimate strength per sq. in.	Elastic limit per sq. in.	Elongation.
Angle iron	47,000	24,000	15%
Plate iron, 20 ins. wide and under	48,000	24,000	12%
Plate iron, Over 20 ins.	46,000	23,000	8%

In addition, all wrought iron must be capable of sustaining the usual cold bending test. The tensile strength, elastic limit and elongation are to be determined from a standard test piece not less than ¾ in -in thickness, and of a section not less than ¼ nor more than 1 sq. in. The finished length of test piece to be at least ten times the smallest diameter of the section. The finished test pieces are to be furnished free of charge by the contractor.

Before assembling for riveting all surfaces to be riveted in contact shall be given one good coat of pure raw linseed oil, thoroughly covering the surfaces; and all iron work before painting is to be thoroughly cleansed from loose scale and rust. All iron work under the planking, except the fascia beam, is to receive three coats of the No. 2 "P. and B." paint, manufactured by the Standard Paint Co., of New York, one at shop and two after erection, previous to putting floor in place. The balance of the iron work is to have three coats of paint, one at shop and two after erection; the paint to be of such color as may be directed, and may be either white lead and linseed oil paint or the asphaltum paint made by the National Paint Works. The wheel and foot guards, and the boxing between the guards and main girders, are to receive three coats of the same paint as specified for upper portion of iron work. The top surfaces of all stringers are to have two coats of same paint as used for lower portion of iron work. No painting is to be done in wet or very cold weather, and any paint damaged before drying is to be repainted.

House Drainage from the Architect's Point of View.*

From year to year a larger percentage of the more expensive and better class of building operations are conducted under the direction of a guild whose province is to adjust the work of the different trades represented without detriment to either, and to produce a convenient and attractive arrangement of the whole, with such artistic touch as shall give the complete work good repute with people of good taste.

Be the problem a monumental pyramid or a modern nineteen-story temple of trade with the small end down—built for the double purpose of astonishing the rustics and depriving the neighbors of as much good air and sunlight as possible—the architect is expected in either case to secure a stable structure.

He is usually further required to connect the building with the receptacle for most of the filth of a large city in such manner as to insure its occupants against contamination from the disease germs in which this filth is supposed to abound. In most cases the designer has nothing to do with the ultimate disposal of the waste matter from the building in question. His task ends with seeing that it is properly discharged into the street sewer through pipes, and his motive power is water. His work is the proper selection and arrangement of the fixtures, the supply pipes and waste pipes. The last of these tasks is enough to consider in this paper.

A STUDY IN PIPES.

The device of water sealed "traps" between the sewer air and that of the house is so universal and so necessary in most cases that we need consider no other. The preservation of this water seal is the requirement to which all others are subordinate. To give some notion of the delicacy of this seal it may be said that with traps ordinarily found on the market, should the air on one side suddenly become 1-250th to 1-300th lighter or heavier (rarer or denser) than that on the other, the trap would lose its seal; and a water seal 4 ins. deep is broken by an inequality of air pressure of 1%. Yet slight as is this defense, it is, if properly put in, more certain than any other in use.

The designer of a system of plumbing waste pipes for a modern building is usually met at the outset by a sort of local compulsory education—the building ordinance of the city, town or village in which the work is done. This building law may be that of New York or Boston or Slackwater or Kankazoo. If of New York or Boston, it contains the ideas of some high authority of a decade or two ago, edited by some committee of the common council who knew nothing of the subject; if of Slackwater or Kankazoo it is probably the New York ordinance still more edited by the council committee on ordinances of the city of Slackwater or of Kankazoo. In the event of being fortunate enough to evade these antiquated regulations, if he has not studied and observed the question independently, the architect of our day is more apt than not to fall into the hands of some "good authority" whose notions will lead to a course entailing mourning upon the architect's client. He must look sharp or theories will get themselves substituted for the conditions which confront him.

Let us assume a case of simple house job, with a bathroom containing three fixtures on the second floor, two fixtures located on the first floor and four fixtures in the basement, the house plan being such that all these may be grouped around a vertical pipe, *P*. Figs. 1 and 2, commonly known as the soil pipe. The sketches do not represent the joints, and the position of the fixtures is arranged to illustrate the principles to be set forth at the expense of exact details. This soil pipe is usually of cast iron in sections, which are secured by caulking with lead. It should be coated with asphaltum inside and out at a temperature somewhat above that of boiling water. All branches from it should be Y-formed. It should be firmly sustained and shrinking timbers should form no part of its support. It should be tested with air pressure at not less than ten pounds per square inch. Water pressure may be substituted, except in freezing weather. Ether and essential oil tests are unreliable except under pressure. It should be extended into and above the top of a chimney with a uniformly good draft, preferably the kitchen chimney, as that being heated at all times of the year is least liable to have its draft reversed. It should run out of the house through a warm flue, to prevent being choked with frost condensed from the moist air it carries off. An open globe-shaped wire screen should cover the top. It should be larger than any of its branches and should be enlarged from its uppermost branch to its outlet above the roof. It should run to the sewer without obstruction and with the sharpest pitch attainable.

Some of these precautions are usual. The soil pipe is commonly extended above the roof, but frequently as at *X*, Fig. 1, when it becomes subject to the same laws as "smoky chimneys." *C* shows a chimney in a position which everybody knows results in down drafts. The air blowing in the direction *W* is obstructed by the roof and condensed for a distance, when the air in the chimney, being of less density, yields to the greater density or pressure of the outer air and is forced down. With the wind as at *E* the air over the top of *C* is somewhat rarefied and that of the flue rushes out, giving a good draft. To give a good draft at all times, *C* must be extended above this area of varying density, as in Fig. 2. The position *X* for the soil pipe is, however, good enough for nearly all the building ordinances and some sanitary authorities. I have watched the trap water rise and fall 1¼ ins. during a boisterous wind in a job where the soil pipe ended as at *X*. "Back air" pipes do not relieve such cases in the least, unless possibly when extended to the opposite side of the obstruction, and would then rarely act quickly enough to give relief. One may look in vain in the "good authorities" for any reference to this menace by the winds. I am convinced that soil pipe air is often blown through shallow water seals, with or without back air pipes to the traps, because of locating the soil pipe outlet badly.

Whether soil pipe air be supplied from the sewer direct or through a fresh air inlet *F*, it carries much moisture, which in a cold day condenses on the inside of *X*. If this proceeds far enough it constricts the air passage so that it becomes useless as a ventilator.

It is in many cases well to wrap the soil pipe in the attic with a non-conductor. For the double reason of keeping the soil pipe extension free from frost and of disposing of its foul air with the smoke and bad air of a good chimney we should always extend the soil pipe above the roof inside a warm flue.

A large percentage of the "ventilators" or "cowls" for the tops of flues and pipes are merely obstructions to the drafts therein. They are rarely of use except as sometimes lengthening the pipe or flue.

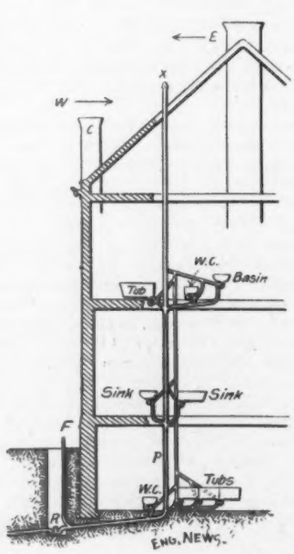


FIG. 1.

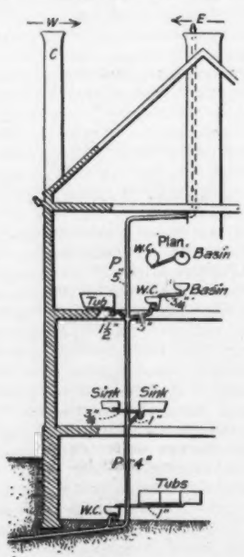


FIG. 2.

FIG. 3.

Plumbing tests are a snare for the feet of the unwary. The profession is not without its inventors. Plumbers have been known to test a waste pipe system with water when the pipes were colder than 32° Fahr., or to coat the inside with ice in cold weather, pending an air pressure test. The time honored peppermint and kindred tests except under pressure are worthless, because a well placed soil pipe will "draw" like a good flue, taking in air from without through all holes.

Near the point where the soil pipe leaves the house is a device hard to mention without some of the forbidden

*A paper by Mr. F. G. CORSER, in the *Northwestern Architect.*

adjectives. All agree that a thorough airing of the soil pipe is desirable, so therefore high authority has decreed that a "running trap," *R*, shall be used in connection with a fresh air inlet, *F*. This running trap not only prevents the sewer air from passing through the soil pipe and off with the disinfecting gases of the chimney, but often causes it to be discharged under your nose as you pass along the sidewalk. The running trap also now and then lays firm hold of some obstruction that has made its way through the W. C., and you are soon notified by an overflow of foul waste water at the lowest fixture that a plumber "and helper" must be sent for. As a matter of course the pipe *F*, being usually smaller, is plugged at this time, and generally remains so, the plumber rarely cleaning it with the trap. Its usefulness, if ever it had any, is then gone. This pipe, *F*, when in operation is further liable in northern latitudes to supply air so cold as to cause trouble all along the line. The combination is such an unalloyed nuisance that it is now losing ground.

Lateral pipes connecting fixtures with the soil pipe are often subject to strain from the settlement incident to shrinking timbers, for which reason the branch should consist of a lead pipe or other sufficiently flexible device. These lateral branches should enter singly and be somewhat smaller than the soil pipe, as they may serve fixtures whose discharge may otherwise act as a sort of piston in the soil pipe, disturbing the equilibrium of air density or pressure enough to unseal the traps.

Coming now to the traps, let us glance at Fig. 3, in which a fixture is connected by a trap with a soil pipe of larger bore. In this position any discharge of the fixture through the trap will leave a good seal; but if we extend the connecting pipe as dotted at *L*, the water will in the longer fall acquire a speed which will not permit the air to pass back in the same pipe fast enough to keep the equilibrium, and the trap water will be siphoned out (self-siphonage). If the pipe empty a sink or bath tub, the chances are good that the slow flow from the flat bottom will refill the seal; but the basin, being somewhat funnel-shaped will not. Again, if a large discharge occur quickly through the soil pipe from an upper fixture, the air is apt to be so condensed ahead of it that some soil pipe air will be forced through the trap seal (back pressure); or so rarefied behind the discharge that the trap will be unsealed and the water emptied into the soil pipe after the larger discharge has passed (siphonage). From long disuse the trap water may be evaporated. Again, a shallow seal is doubtless sometimes lost by capillary work, shreds of cloth or hairs lodging so as to effect that result.

Now this is a formidable array to attack so slight a defense. The novice naturally inquires if an inequality of air pressure amounting to 1% or less is enough to overcome the water seal of the trap, and if it is so easily lost by either self-siphonage, back pressure, siphonage or varying wind pressure over the top of the soil pipe, why are we who live in houses connected with sewers not long ago killed off? First, because the sewer air of any given part of a large sewerage system rarely contains active disease germs; Second, because the house air is much more often drawn into the soil pipe than the soil pipe air into the house.

But these large factors in favor of health do not absolve the plumber, the sanitary engineer or the architect from the duty of doing a good and intelligent job.

It is now some fifteen years since this loss of the water seal of traps came prominently before the public, and not long after the air pipe (see Fig. 3) was heralded as a specific. Its use was soon advocated by high authorities and became a part of the building law of most large American cities. One of the foremost sanitary engineers of this country shortly afterward showed by a conclusive series of experiments that with the soil pipe and traps properly designed and placed, no necessity existed for these special pipes.

The use of the special pipes adds 5% to 10% to the cost of plain but good house jobs. They are never flushed, and if broken or cut they never give notice to the housekeeper by leaking water, and holes in them may establish communication between house and soil pipe air for almost any length of time, until accident or illness shall lead to its discovery. They more often than not become constricted or entirely plugged at the crown of the trap with the solids of the discharge, and this may occur with a few months' use. It is so certain to occur that work depending upon these pipes for efficiency is soon as badly off as if they were not present. Yet the "back air" vent pipes are to this day well intrenched in nearly all building laws and well defended by "high authority."

As we would expect, a multitude of traps have been patented and sold to prevent the loss of the water seal from siphonage, etc. A few are very good and very nearly "self scouring," while many are valueless after short use. A class consist of enlargements of the bent pipe forming the plain trap. These, owing to the slower flow of the waste matter through the enlargement, are apt to collect filth at this point until the size of the opening remains only the size of the bore of the waste pipe. Another class contain mechanical devices which obstruct the passage of the wastes and soon become worthless. One of the best takes air from the house at the crown of the trap, all movement of air from the soil pipe toward the house being prevented by an inverted cup nearly balanced in mercury. While this is almost perfection it does not remove the chances of choking the opening at the crown of the trap.

HETERODOX SANITATION.

To get a notion of how to avoid the expense and often worse than uselessness of these time honored devices, look now at Fig. 2, which represents the same requirements as Fig. 1. Here we have a much safer and simpler job than in Fig. 1, and a job much more apt to remain so. Beginning at the bottom we will omit the "running trap" *R* and fresh air inlet *F*, by doing which we will ventilate the sewer above the house top rather than at the street or lot level; we will not be forcing soil pipe air through *F* where we will likely get a whiff of it; we will at the same time remove the chances of too cold a draft through *F*, and will lay aside $25 for use elsewhere. Instead of connecting the laundry tubs with the soil pipe direct we have a W. C. so placed that by a slight readjustment of levels we can discharge the wastes of the tubs through a rather small pipe over the edge of the W. C. into its trap. In this way we will have scarcely more surface of waste pipe exposed to the house air than is usual between fixture and trap, and we will forever remove any danger from sewer air through three fixtures. There will be no clogging of traps and we will save another $25 or so. The W. C., with its short branch to the larger soil pipe, will not be subject to siphonage in any form if the branches for waste pipes above it are smaller than the soil pipe. On the first floor we will make a sink waste pipe with slight fall and deep seal. The pantry sink being near, we will waste into that of the sink above the trap. In the bathroom we will, as the position of the fixtures readily admits, run the basin waste through a small pipe over the edge of the W. C. into its traps. The small inner surface of these waste pipes may be scalded or wiped clean at any time, and we have laid aside, say, $10 for better uses.

Just above the upper branch we will enlarge our soil pipe as dotted to insure a free movement of air therein, and we will continue it through a warm flue to the top of the most used chimney in the house. Having tested our soil pipe and branches for leaks, we will now try all possible tests of the efficiency of the water seals that are likely to occur in practice, and we will find that the operation of any fixture will not disturb the trap seal of any other nor of its own; nor will the boisterous wind agitate the trap seals to their hurt.

We will have water seals at least 4 ins. deep, formed in simple bends of the waste pipes with threaded plugs at the bottom, if we cannot secure simple self-scouring traps on the market. This form will be much more apt to continue clean than if more complicated. Having no use for special air pipes we will omit them, and put say $25 more aside for better uses.

This simple job will have the vital merit of much greater staying qualities than any with the usual complications; but it must be owned that in the present stage of city building regulations it is often very hard to bring about such work. The more advanced practice may in time prevail to such an extent as to leave the use of the time honored complications which it omits, optional. If we finally get reasonable by-laws, the building will require sound construction of waste pipes with the main features outlined above. They will also require two official tests, one for soundness of pipes, the other for efficiency of water seals, and these tests should carry certificates with them.

In conclusion, I do not wish to pose as an authority, but to call attention to the unscientific ways of the authorities with which the science is at present handicapped. The proportioning of pipes and trap seals is a very crude art as generally practiced. As to the changes and short cuts suggested, their efficiency has been so often verified in my own practice as to give them the force of conviction. Unless the evidence of several observers for whom I have great respect and my own senses are at fault, many things in standard plumbing are not only redundant, but unsafe.

PERSONALS.

Mr. S. S. NEFF has been appointed Superintendent of the Fairhaven & Southern and Seattle & Northern railways.

Mr. GEORGE G. ROBERT died at Cumberland, Md., Sept. 6. He was connected with the preliminary surveys for the Northern Pacific R. R., and was connected with other engineering works.

Judge T. M. COOLEY, one of the Interstate Commerce Commissioners, has resigned on account of ill health. He was appointed in 1887, and was chosen as chairman of the commission, in which position he did a large amount of valuable work which aided considerably in securing respect for the decisions of the commission.

Mr. C. N. CHEVALIER, Division Superintendent of the New York & New England R. R., has been appointed General Superintendent of the Government Railways of Nicaragua, with headquarters at Managua. There are 91 miles of narrow gage rail, and a steamer line of 30 miles connecting two portions of the railway, as described in our issue of Aug. 29.

Mr. VERPLANCK COLVIN, nominated on the Republican ticket for State Engineer and Surveyor of New York, was born in Albany, N. Y., on Jan 4, 1847. He is well known in connection with his surveys of the Adirondack forests for the State. Mr. EUGENE F. O'CONNER, nominated on the same ticket for Secretary of State, was also a civil engineer, and was at one time on the survey of the Union Pacific Railway. Mr. MARTIN SCHENCK, of Schenectady, N. Y., has been nominated on the Democratic ticket for State Engineer and Surveyor.

NEW PUBLICATIONS.

—*Association of Dominion Land Surveyors.* Report of Proceedings at the Eighth Annual Meeting, Ottawa, Ont. Feb. 17 and 18, 1891.—Paper, pp. 171. Price, 50 cts.

In addition to the minutes of proceedings, the following papers, with discussions, are given: "Corrections of a Traverse," "The Marking of Surveys in Cities and Towns," H. G. Dickson; "The Contractor," John McAree; "Survey of Railway Lines," Samuel Bray; "Wharton's Gnomonic Projection," Boulton; "Latitude by Prime Vertical Observations," O. J. Klotz; "Examination of Northwest Lands, C. P. Ry.," L. A. Hamilton; "A New Signal for Mountainous Districts," L. A. Dufresne; "The Mining, etc., of Low Grade Ores," James Brady; "Mining Prospects of West Algoura," Sewell; "Relation of Mountain Forms to Geological Structure'," "Field Observations for Azimuth," W. F. King; "Solar Attachment to the Transit Instrument," J. I. Dufresne; "Surveys of Right of Way for Railways," H. Irwin; "Subdivision Work," J. Vicars; "Photography in Colors."

—*The Rivers at Johnstown, Pa.*—Report to the Board of Trade of the City of Johnstown, by J. J. R. Croes, C. E., June 15, 1891, 8vo, 32 pages, with maps and 32 illustrations. Price, $1. Sent postpaid on receipt of price by ENGINEERING NEWS PUBLISHING CO., *Tribune* Building, New York City.

We have already called attention to this report as presenting in succinct form the result of the examinations made by the author to dispel the uncertainty existing in the minds of the citizens of Johnstown as to their security against damage from freshets. This feeling of insecurity extended beyond the city, and has proved a serious detriment to the re-establishment of business and the restoration of material prosperity to Johnstown, in consequence of the unwillingness of capitalists to make loans or investments in a place suspected of being liable to destruction from sudden floods. The engineer appears to have made a thorough investigation of the sources of danger, and has set forth in a clear and forcible manner the result of his examinations, with the general conclusion that the remedy against any disaster reasonably likely to occur lies easily within the reach of the citizens themselves. It would not be easy to condense a document already so concise as this is, and presenting the whole case so plainly and so thoroughly, both in the text and the well selected and artistically reproduced illustrations. It should be read by all who are interested in such matters.

—*Progressive Examinations of Locomotive Engineers and Firemen.* With diagrams illustrating the manner of using signals according to the standard code of train rules as adopted by the American Railway Association. John A. Hill, New York. Limp cloth, 4 × 6 ins., pp. 97. Price, 50 cts.

The plan of progressive examinations, suggested by Mr. Hill, consists of examining the man at the end of each year's service, in order to ascertain if he is making proper progress. This plan was favorably reported upon by the Committee on Examination of Engineers and Firemen at the last meeting of the American Railway Master Mechanics' Association, as reported in our issue of June 20, 1891, and several roads are said to have already decided to adopt this plan. The education of these employees is a very important matter, and as continual improvements are being made in locomotives to increase their efficiency and economy in operation, it becomes necessary to have the engines handled by men who thoroughly understand and attend to their work and keep up with the progress made in the mechanical work, in order to obtain the full benefits of these improvements. As the author states in his preface, the future locomotive engineers (we prefer the term engine drivers) of this country will need a different and, perhaps, a better education in their business than has been required or demanded in the past. The first few pages are devoted to a general explanation of the proposed system of examinations, some extracts from which are given elsewhere. Instructions to examiners and candidates and advice to firemen are also given. About 50 pages are then devoted to sets of questions for each of the three years' examinations, with concise answers. It is explained that the exact questions given will not be asked

by the examiners, but they indicate what will be the character of the examinations. The questions and answers treat only of such parts of mechanism and such conditions as are common to all locomotives and to all railways, and it is expected that the officers of each road will add important subjects of a local nature, such as the water scoop on the Pennsylvania, the smoke-jet on the New York Central, and the water brake on the Rocky Mountain roads. A little "lecture" from the examiner is added to each examination. The examinations appear to be very comprehensive, and firemen who study this book, and attend to their practical work so as to be able to pass their examinations, should be men who will be valuable employees for the company. The diagrams show the positions of flags and lamps for train signals by day and night.

SOCIETY PROCEEDINGS.

Roadmasters' Association of America.—The ninth annual convention was held at Minneapolis Sept. 8, 9 and 10. The first session was opened with speeches by President Doyle, Mr. J. MacMillan, President of the North-Western Track & Bridge Association; Vice-President W. H. Stearns, Mr. Isaac Burnett and Mr. J. M. Meade. The roll call showed about 120 members present. At the afternoon session Secretary Ramsey presented his report, showing 42 applications for membership, making the total membership of the association nearly 800. The expenditures during the year were a little over $1,000, and a little over $1,000 is now in the treasury. The dues unpaid amount to about $700. The presentation and discussion of committee reports was then taken up as follows:

Standard Frogs.—The committee recommended for main track turnouts a 1 in 10 spring rail frog for all weights of rail above 60 lbs.; for yard use a rigid frog not less than 1 in 8. There was a long discussion over this report, principally over the well worn topic of the safety of spring rail frogs, their advantages over rigid frogs in durability, and the wisdom of specifying the frog angle, as was done by the committee. Two motions to amend the report were defeated, and it was adopted as read.

As the report makes no provision for the railways which use rails lighter than 60 lbs., such roads will have to use their own judgment in getting from the main tracks onto a siding. Perhaps the committee thought nobody ought to use rails lighter than 60 lbs. on a road doing a general traffic business, in which they were doubtless correct.

Two papers were read on this topic, one by Mr. I. Burnett and one by Mr. W. F. Ellis. We extract the following from Mr. Burnett's paper:

The rails used in the construction of frogs should be first class, and should be reheated as little as possible; the frog point should be planer work only, not heated. The wing rails should not be bent cold. The planing of the point should be so perfect that a line drawn through the frog from toe to heel will touch the entire length of the point. The point should not exceed ⅛-in. thickness at the end. The throat opening, or flangeway, should not exceed 1⅞ ins.; then if the frog lines properly, the opening at the knee will be the same as the throat opening, 1⅞ ins.

The workmanship should be perfect. In a riveted frog the holes in the rails and plate should coincide accurately. In a clamped or bolted frog the filling blocks should be planed to fit the filling space, and a wedge shaped piece of iron should be fitted between the rails forming the point. This wedge should be 10 ins. long in a No. 10 frog.

I would recommend a frog to be 10 ins. long, 4 ft. from toe to point, and 6 ft. from point to heel for Nos. 8 to 11. The distance from point being 6 ft. will give ample room for fishing angles from 26 to 30 ins. long, but I see no reason why all frogs should be made to allow the use of 48-in. angle bars when so few roads are using them.

A frog properly made and maintained would, I believe, give better results from them than we are getting to-day. I have measured new frogs having a throat opening upon one side 1⅞ ins. and upon the opposite side 2¼ ins., and the point for 8 ins. back from actual point was from 1/16 to 3/32 in. lower than the wing rail. This is a serious fault. I have taken apart frogs where the filling block was forge work, and poor at that. Again, after the frogs are delivered to the company, what treatment do they receive in laying and maintenance? Plate riveted frogs are often laid upon ties not properly adzed to bring the frog on a level with the adjoining rails. I find it a practice with many trackmen to spike their frogs, as they say, a little loose gage—that means from ⅛ in. to ¼ in. This should not be allowed, and great care should be taken in keeping frogs to perfect gage. I have measured many frogs in track in the past six months, and found the gage to be from ¼ in. to ⅝ in. wide, while the guard rail gave barely 2 ins. flangeway.

Mr. Burnett then described experiments he had made with full size wooden models of frogs and car and engine wheels to demonstrate the injury done by having the frog of wider gage than the rest of the track, and allowing a too wide throat opening. The experiments showed that the more the throat opening was increased, the less was the support which the wheel got from the wing rail and the more the wear on the frog point.

Mr. Ellis' paper discussed danger with spring rail frogs and contended that if properly made the danger was effectively guarded against. The spring rail frog should be kept in good condition and should be made of first-class material. For stiff frogs he advocated limiting the flangeway to 1⅝ ins., and believed there was an element of danger in any flangeway wider than 2 ins., except for crossing frogs.

Rail Joints.—It will be remembered that the Associations is conducting a competitive service test of five new joints, and the report of this committee was looked for with much interest. It was rather a disappointing document, however, opening with a rather needless tribute to inventors, of which the following is a sample:

When we take into consideration the anxious and patient toil of inventors whose hopes are anchored in the success of their inventions, it is our duty if we find merit in an inventive appliance to try it, as hard working inventors are a benefit to their kind, and so entitled to your best consideration.

The committee stated that new joints are not numerous (from which we infer that they do not see the *Patent Office Gazette*). The only joints recommended for trial in addition to those recommended last year were those made by the Continuous Rail Joint Co., of Newark, N. J., and the Heath Rail Joint Co., of Minneapolis. We illustrate the latter in another column. Some letters and statements concerning the results of the trials of the Long truss joint were presented, but it was finally decided that none of the joints now under trial had been in service long enough to justify a report being made upon their practical merits, and the whole rail joint matter was shelved until the next convention.

Track Jacks.—On Wednesday, after some desultory skirmishing with business out of its regular order, the Track Jack Committee presented their report, In view of the great Quincy disaster, when a track jack caused the death of 23 persons and the injury of 30, the committee paid much attention to the question of safety. They had heard of a jack which worked at all times below the rail, but had been unable to find the inventor or manufacturer of such a jack. Their search must have been of a rather perfunctory order, for Clark Fisher, the patentee and manufacturer of the jack referred to, is known by every roadmaster as the inventor of the Fisher bridge rail-joint. They recommended the following types of jack:

For a standard, a double acting, compound lever jack, so constructed as to raise only half a notch at a stroke, up or down, made with two pawls of cast steel; frame to be of malleable iron, the lifting bar to be of the best grade of steel, capable of standing a strain of 90,000 lbs. per sq. in. Bushing to be made of the best quality of cast steel, and so arranged as to be removed and replaced promptly by any ordinary section man.

For ordinary section work, a jack of eight or ten tons capacity, weight not to exceed 60 lbs., with lifting bar not less than 1⅝ ins. × 1⅝ ins. section and to raise at least 12 ins., finished with a base of about 7 × 12 ins.

The committee supplemented this with the declaration that a jack must be had which can be relieved quickly from its load and removed from the track almost instantly when necessary, one that will sustain a large weight on the lifting bar, which is positive in its action, speedy in doing its work and durable in design. The committee hoped the day was not far distant "when a jack will be put on the market so constructed that sectionmen may never say that the jack was the cause of a wreck by reason of some faulty design." Until such a jack is available, however, the committee recommended:

That roadmasters issue more stringent and definite rules with reference to the use of the track jacks, and that wherever it is possible they should be placed on the outside of the rail.

In cases where it has to be worked between the rails and the view is obstructed, always protect the point of danger by a flagman as per time card rules. Should the foreman be short of men for flagmen, and cannot comply with such instructions (which is often the case), then use danger signals in the nature of flags and torpedoes the required distance out from the place of danger. Where jacks are worked on double tracks, the man in charge must never leave it while it is in position under the rail. The chances for striking both man and jack are here double, and every precaution against accidents must be taken.

The discussion was quite interesting. It seems, from the statements of the members, that on very many roads the rules now require jacks to be placed on the outside of the rail in all cases, and a flag to be used when necessary. The relative merits of friction and ratchet jacks were fully discussed, the advocates of the latter getting rather the best of it. Several members expressed the opinion that a lighter jack which could be more easily moved and handled was better than the jacks in common use.

Track Work.—The substance of the report of the committee on this subject was as follows: Sections should be so laid off that each gang will have as nearly as possible the same amount of work. Then when a section falls below the average it may be set down as due to the foreman's incompetency. Bridges, culverts and cattle guards should be kept clear of all inflammable rubbish, and the caps should be kept clear of dirt in order to postpone decay. All places on tracks where a man's foot might get caught should be kept filled. Notches should not be cut in the rail flanges, as it adds to the danger of breaking. Watch the expansion of tracks, especially in the spring, and look out for places where the rails have run together during the winter. The first hot day may cause an accident here if it is not attended to.

From 6 ins. to 18 ins. of good ballast are needed to prevent track from leaving or churning during the winter or wet months.

Track with stone, gravel, burned clay or sand ballast should be trimmed off level with the top of the ties for a distance of ft., outward from the rails; from this point a gradual slope should be given. From the bottom of the slope a shoulder or berme not less than 8 ins. wide should be made. The slope from the shoulder or berme should be sodded to prevent its destruction.

Track with mud or loam ballast should have a shoulder the same as on other ballasts The center of the track should be filled 2½ ins. above the tops of the ties; and there should be a gradual slope outward to the shoulder, or berme, leaving the base of the rail open, and the bottom of the ties bare at their ends.

In changing rails lay rails of the same make and section together. Use 1/16 to ¼ in. expansion blocks, according to temperature. Curve with rail fenders all rails laid on curves.

In shimming track, have shims 1 in. thick or less at least 8 ins. long, and 4 ins. wide, placed diagonally under the rails. Shims over 1 in. thick should be 12 ins. long and not less than 6 ins. wide, spiked to the ties, and with 4 spike holes in each shim for spiking the rails. No shim thicker than ½ in. should be put on curves, and none thicker than ¾ in. on straight tracks, without being well braced. All track shimmed over ¼-in. should be double spiked.

In renewing ties they should be spaced equally. The widest and narrowest ties should be alternated. The best side of all ties should be turned up to save them from being cut into by the rail. Adze ties if necessary to give both rails a bearing the full width of the tie. Drive the spikes between the rails on the same edge of the tie to prevent twisting out of square. Pile up old ties and fill ballast around new ones before quitting work at night.

Surfacing should begin about June 1, each gang commencing on the end of its section furthest away, so that the unsurfaced track can be locked over in going to and from work. Take care in surfacing not to raise the general level, but merely to bring up the low places.

Mow right of way in July or August, and burn the mowed weeds and bushes when dry enough. Surfacing should be completed before wet or wintry weather sets in, and general track repairs, cleaning ditches and repairing fences should also be done.

Foremen should run over their sections daily and make a general inspection. In case of severe storms, a thorough examination of the section should be made before allowing trains to pass over it.

In conclusion the opinion is expressed that roadmasters and engineers order too much Sunday work. No track work except what is absolutely necessary should be done on the Sabbath.

The report of the committee was discussed on Wednesday evening. The form of ballast recommended was criticized, it being claimed that gravel and cinder ballast should slope from the center of the track toward the sides and would not drain quickly enough if placed in the same manner as rock ballast. The recommendation of the committee was finally amended to make the section for sand, gravel and cinders slope enough to give surface drainage. It was also voted, after some discussion, that a rail bender need not be used for curves under 3°.

Tie Preservation.—At Thursday morning's session a paper on tie preservation, prepared by special request, was read by Mr. H. W. Reed. We reprint it elsewhere.

Interlocking Devices.—The committee on this subject in their report gave a brief history of interlocking devices and described various special forms of apparatus made by the Allentown Rolling Mills, the Johnson Railroad Signal Co. and the Union Switch & Signal Co. The committee recommended that interlocking apparatus be used at all grade crossings, yard terminals, tunnels, and drawbridge approaches. Also that in putting in derailing switches at grade crossings, the switch points should be 250 to 300 ft. from the crossing frogs; and that the guard rail be connected with the end of the stock or butt rail, extending parallel with the main rail and 8 ins. distant to a point within 50 ft. of the crossing frogs. There was no discussion.

The committee on the chemical composition of steel rails and on the relative merits of even and broken joints had no reports ready, and the subjects were continued for another year. This concluded the technical work of the convention.

The committee on the design of badges presented a report and a design in bronze was adopted. The cost is $2.50. The following committee was appointed to revise the constitution and by-laws and report at the next annual meeting: I. Burnett, J. Doyle, J. W. Craig, B. Murtaugh, C. E. Jones, J. A. Kerwin, J. B. Moll, G. W. Bishop, W. H. Stearns.

Mr. J. H. K. Burgwin offered a resolution that the association would in future refuse to receive from any one interested in the sale of track tools or appliances any form of hospitality involving expense. There was a lively discussion over this proposed spasm of conscientiousness, and on a vote the resolution was lost. The election of officers was then proceeded with. President Jno. Doyle and Vice-President W. H. Stearns were re-elected. Mr. J. B. Moll was elected Second Vice-President in place of Mr. Jas. Sloan, and Mr. O. F. Jordan was chosen a member of the Executive Committee. Mr. H. K. Burgwin, of the Grand Rapids & Indiana (headquarters, Grand Rapids, Mich.) was chosen Secretary. For the next place of meeting Chattanooga received 47 votes and Atlanta 40, and the next convention will hold sessions in both cities. The time of holding the convention was changed to the third Tuesday in October.

EXHIBITS.

Of course the rail joint and nut lock men were on hand. In the former class the exhibitors were Mr. Geo. A. Weber with the Weber joint, one of those being tested by the Executive Committee of the association; Morris Sellers & Co., with the Samson splice-bar; the Continuous Rail Joint Co., of Newark, N. J.; the "continuous" rail joint of the McConway & Torley Co.; the Long Truss Rail Joint Co.; the Anderson joint; the Heath rail joint, elsewhere illustrated, and a boltless joint from West Virginia.

In nut locks, Metcalf, Paul & Co., exhibited a placard, tantalizing enough to their younger competitors, announcing that 182,000,000 Verona nut locks had been sold to date. The National Nut Lock Co. claimed a sale of 50,000,000 for their locks The other nut locks on exhibit were the Standard, Excelsior, Jones' Positive, American and the Harvey grip thread bolt. The Servis tie plate the Edwards rail brace and the Alkins forged steel rail brace also deserve mention in this connection.

In switches, crossings, switchstands, etc , the exhibitors were the Weir Frog Co., the Morden Frog & Crossing Co., the Cleveland Frog & Crossing Co., the Kansas City Switch & Frog Co., the Fontaine Crossing Co., the National Malleable Castings Co., and the Ajax Forge Co. The Dunn safety switch, described in our issue of Aug. 23, 1890, was also shown.

In track tools, jacks were a prominent feature, the principal exhibitors being Fairbanks, Morse & Co., Joyce, Cridland & Co., the McSherry Mfg. Co., and Pettibone, Mulliken & Co. Hand cars were shown by the Buda Foundry & Mfg. Co., and Fairbanks, Morse & Co. Other track tools were shown by Metcalf, Paul & Co. and Avery & West. The Goldie and Greer spikes, the National and Bush surface cattle guards and the McMullen woven wire fence were among other exhibits worthy of note.

National Electric Light Association.—The fourteenth convention was held at the Windsor Hotel, Montreal, P. Q., Sept. 7 to 11 inclusive. At the opening session the members were welcomed by Mayor McShane, Sir Donald A. Smith, Sir J. W. Dawson, President of McGill University, Professor Bovey, and prominent officials of the city. Replies were made by Mr. Knapp, U. S. Consul-General; Hon. E. A. Armstrong, and Hon. Erastus Wiman.

President C. R. Huntley, in his address, advocated the zone system of distribution of electric currents, the potential of the current varying according to the distance of transmission, and converters being used to reduce the pressure for local distribution. He believed in the plan of using large converters to reduce the voltage for a considerable district, instead of furnishing a converter to every consumer. He advised the designers of central stations not to plan their capacity for a growth of more than five years. New inventions may at any time increase the lighting capacity of a given plant fivefold, or even tenfold. Concerning the placing of wires underground, progress in that direction is necessary; but the work is hampered by the interference and restriction of the public authorities. If every house had its system of wiring as it has its gas and water pipes, the subway problem would be a comparatively easy one. The public, however, has to pay for the extra cost of underground service, a fact it has not yet realized. In most cases it is as unreasonable to demand underground wires as to demand the abolition of all grade crossings on railways. "But for our overhead wires, America would not be to-day the great land it is of electrical triumphs; and while I hail with delight every advance in the solution of the underground problem, I hope long to gladden my eyes with the sight of a pole well set and a wire well strung."

Municipal ownership of electric light plants he did not believe in; but thought that the best possible argument against it was for the electric lighting companies "to give the very best service possible at the lowest rates compatible with fair profit." What "fair profit" was, and how and by whom it was to be fixed, he did not explain. In conclusion he recommended that annual conventions be substituted for biennial.

The technical work of the convention was then taken up. Over the report of the committee on "The Relations Between Parent and Sub-Companies" there was an exceedingly warlike discussion, which we have discussed editorially.

Mr. J. A. Hornsby, Secretary of the Electrical Department of the World's Columbian Exposition, described the progress which had been made and the prospect that an International Electrical Congress would be held in Chicago in 1893. Messrs. Sweeny, of Chicago, Coleman, of Milwaukee, Hart, of New Orleans, Rice, of Washington, and Price of New York, were appointed a committee to co-operate on behalf of the association in the preparations for such a congress. The committee on forms for recording data concerning street lights presented a form which was adopted with a resolution requesting the Census Bureau to follow this form in its statistics. There was an interesting discussion over the report of the committee on legislation in which the important point was brought out that adverse legislation was sometimes due to faults in the management of the electric companies.

The Committee on Underground Conduits reported progress, and was continued for another year. The Committee on Safe Wiring submitted an important report, which we shall reprint next week. News was received during the convention that the census department had dropped all investigations in charge of expert special agents, including the electrical statistics in charge of Allen R. Foote. Resolutions were adopted urging the carrying on of the electrical census without delay; and a committee of five was appointed to take the resolutions to Washington and secure, if possible, the continuation of the work without delay.

The papers read at the convention were on "Central Stations Operated by Water Power," by George A. Redman; "A Central Station Combining the Advantages of the Continuous and the Alternating Current Systems," by H. Ward Leonard; "Uniformity in Keeping Central Station Accounts," by J. J. Burleigh; "Three Years' Development of Electric Railways," by Eugene Griffin; "Electric Railway Construction and Operation," by C. J. Field; "Details of the 'Municipal' Arc Lighting System of St. Louis," by James J. Ayer; and "Different Forms of Carbons Used in Arc Lighting," by F. P. Warner.

At the business session the secretary reported an active membership of 78 and an associate membership of 142. The treasurer's report showed $1,122 cash on hand, and expenses during the year of $1,387. The next meeting will be held in Buffalo, N. Y., in February.

Master Car Builders' Association.—The Executive Committee has arranged the following subjects, and committees to report upon them in June, 1892:

Joint Inspection.—To prepare a supplementary set of interpretations and illustrations of the Rules of Interchange. Committee: A. M. Waitt, H. C. McCarty, F. D. Adams, Wm. Garstang, Joseph Townsend, J. T. Chamberlain, D. W. Hunter.

Air Brake and Signal Instructions.—To review the instructions proposed at last convention. Committee: E. W. Grieves, R. D. Wade, J. L. Greatsinger.

Cast Iron Wheels.—To investigate what improvements are being made in the manufacture of wheels, so as to secure greater uniformity in quality, in depth of chill and in distribution of metal for proper balance. Committee: Geo. W. West, W. H. Thomas, John Player.

Freight Car Truck Frames.—To report upon the relative advantages of swinging and rigid bolsters, and upon the Fox Pressed Steel Truck as compared with the prevalent forms of freight car trucks. Committee: G. F. Wilson, W. S. Morris, W. F. Turreff.

M. C. B. Automatic Coupler Standards and Limits.—To consider the standard measurements, and whether any additional or other measurements are desirable as standard, and to report upon proper limits of variation to be allowed from standard measurements. Committee: J. S. Lentz, C. A. Schroyer, J. M. Wallis.

Steam Heating and Ventilation of Passenger Equipment Cars.—To report upon the general progress and the efficiency of different systems, and to present drawings for a proposed standard location of ends of train pipe, and a proposed standard connection in detail for a union between the hose and pipe, so that one style of coupling may be readily removed and another substituted in its place. Committee: J. N. Barr, J. C. Barber, W. H. Lewis, T. A. Bissell, J. W. Marden.

Steel Tired Car Wheels.—To report upon relative merits of solid cast and wrought centers, and of plate centers bolted to hubs and tires. Committee: R. E. Marshall, J. O. Pattee, C. H. Cory.

Wheel Guarantee.—To consider the communication from the Wheel Manufacturers' Association, read at last convention, and to report with recommendations. Committee: J. J. Hennessey, Thomas Sutherland.

Steel Plate and Malleable Iron in Car Construction.—To recommend a standard for stake pockets, and a method in detail for attaching to cars. Also to recommend standards for center plates, in detail, showing one for iron transoms and one for wooden transoms. Drawings and models to accompany the report. Committee: Wm. Forsyth, John Mackenzie, E. D. Bronner.

Standards of the Association.—To consider the standard already adopted by the association, and recommend what measures are expedient to secure their general adoption and use. Committee: R. H. Soule, E. Chamberlain, Wm. McWood.

Metal for Brake Shoes.—Committee: G. W. Rhodes, E. B. Wall, Geo. Gibbs. Jno. W. Cloud, Secretary.

American Society of Civil Engineers.—At the regular meeting, Sept. 16, Vice-President A. Fteley in the chair, the Secretary read a paper by Mr. George Y. Wisner, M. Am. Soc. C. E., on "The Brazos River Harbor Improvements." The paper commenced by a record of the various projects for the improvement of the Brazos River and the harbor at its mouth, in Texas, since 1845, when a company was organized to make a harbor and build a city at the mouth of the river. Several reports upon the proposed harbor have been made by officers of the U. S. Engineer Corps, and in 1887 it was reported that "the degree of improvement needed is impracticable and that the attempt to make any improvement at all is a costly and doubtful experiment." The paper claimed that the report was based upon meagre and misleading information without a careful study of the physical characteristics. After the U. S. Engineer Corps had abandoned the scheme as impracticable, the Brazos River Channel & Dock Co. obtained authority by a bill before Congress to improve the harbor at its own expense. Mr. E. L. Corthell, M. Am. Soc. C. E., was the first chief engineer; Mr. Wisner was resident engineer, and made a careful examination of the harbor and vicinity. Mr. Corthell proposed a plan for the construction of the jetties which was described in ENGINEERING NEWS, June 22, 1889, but the plans and method actually adopted were designed by Mr. Wisner and described in ENGINEERING NEWS, May 18, 1889. A view of the work was also given in our issue of April 4, 1891. Financial troubles have hindered the progress of the works, but they are said to be well advanced, and will be carried out on the original plans by Mr. A. E. Kastl, M. Am. Soc. C. E., who is now the engineer. The results so far obtained are said to show that the desired effects will be obtained when the works are completed. The plans provided for concrete coping walls on the portions exposed to wave action, but these have not been built owing to the expense, although it is stated that they will probably add largely to the effect of the jetties, as has been found to be the case at the South Pass of the Mississippi.

Written discussions by Col. O. H. Ernst and Mr. R. E. McMath were read, and the paper and discussions showed the feeling still existing between the civil and military engineers. It was pointed out that the paper dealt with work not actually completed, and that the army engineers are hampered to some extent by regulations they have to comply with and by small appropriations. This is a matter which we have discussed from time to time.

A discussion by Mr. Hutton on the paper by Mr. J. Foster Crowell, on "Characteristics of the Ravine du Sud, in the Island of Hayti, and Plan for Averting its Overflow," was then read, and Mr. Crowell made some further remarks upon his paper, which has already been published (*Trans. Am. Soc. C. E.*, June, 1891).

Papers were announced as follows: Oct. 7, "Description of the Whaleback Steamer"; Oct. 21, "On the Rochester Water-Works," by Mr. Rafter. The meeting then adjourned.

American Institute of Mining Engineers.—The sixtieth meeting will be held at Glen Summit, Luzerne County, Pa. (on the Lehigh Valley R. R., between Mauch Chunk and Wilkesbarre), beginning Tuesday evening, Oct. 6. The Chairman of the Local Committee is Hon. Eckley B. Coxe, Drifton, Pa. There will be an excursion in the Lehigh region, including visit to the iron breakers of Coxe Bros. & Co., and to collieries where large anthracite seams are worked by stripping off the overlying strata.

The following papers have been announced: "Electricity in Mining, as Applied by the Aspen Mining and Smelting Company," M. B. Holt, Aspen, Col.; "Electric Locomotives in German Mines," and "The Manufacture of Liquid Sulphurous Acid in Upper Silesia," Karl Ellers, Berlin, Germany; "A Chinese System of Gold Milling, Henry Louis, Singapore, Straits Settlements; "The Utilization of Puddle Slag for Paint Stock," Axel Sahlin, New York City; "The Florence Oil Fields, Colorado," George H. Eldridge, U. S. Geol. Survey, Washington, D. C.; "A Survey of the Planches de Plata Mines, Sonora," Henry M. Stanley and Henry O. Flipper, Nogales, Ariz.; "Co-ordinate Surveying," Henry O. Flipper, Nogales, Ariz.; "Cordwood in the Matting Blast Furnace," Herbert Lang, Mineral, Idaho; "The Bendigo Gold Field," T. A. Rickard, Allemont, Isère, France; "Apparatus for the Manipulation of Iron and Steel Plates during the Process of Finishing," and "The Handling of Ingots and Molds in Bessemer Steel Works," Gram Curtis, Pittsburg, Pa.; "Centrifugal Ventilators," R. Van A. Norris, Wilkesbarre, Pa.; "Tandem Tanks for Hoisting Water from Flooded Slopes," J. H. Bowden, Wilkesbarre, Pa.; "The Utilization of Anthracite Waste by Gasification in Producers," W. H. Blauvelt, Philadelphia, Pa.; "The Use of Magnetic Concentrates in the Port Henry Blast Furnaces," N. M. Langdon, Port Henry, N. Y.

Special attention is called to the paper of Mr. Norris on "Centrifugal Ventilators," which will give the results of tests of the efficiency of numerous different forms, and which, it is hoped, will call out a valuable discussion. Those who desire to have the paper in advance for the purpose of preparing contributions to the discussion will be furnished with proofs. Special discussions are expected upon "The Preparation and Utilization of Small Sizes of Anthracite Coal," and "The Practical Uses of Concentrated Iron Ores." R. W. RAYMOND, Secretary.

Engineers' Club of Cincinnati.—The regular monthly meeting was held Aug. 20, with 24 members present.

Short papers by various members, on the following subjects, were read: Traveling Cranes; The Width of Roadway in City Streets; Settlement of Embankments; Remarks on Water Feeding of Stationary Boilers; Railway Spirals; Proposed Classification of Engineers; State Inspection of Bridges.

The papers excited considerable discussion, and the last one was referred to the Standing Committee on the subject.

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AND

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COMING TECHNICAL MEETINGS.

Engineers' Club of Minneapolis.—Oct. 1. Rooms, Public Library Bldg. Secy., F. W. Cappelen.

Association of Civil Engineers of Dallas.—Oct. 2. Secy., E. K. Smoot, 803 Commerce St.

Technical Society of the Pacific Coast.—Oct. 2. Secy., O. von Geldern, 819 Market St., San Francisco.

American Society of Swedish Engineers.—Oct. 3. At 250 Union St., Brooklyn, and 347 North 9th St., Philadelphia.

Northwest Railroad Club.—Oct. 8. Rooms, Union Station, St. Paul.

Civil Engineers' Society of St. Paul.—Oct. 5. Secy., C. L. Annan.

Engineers' Club of Kansas City.—Oct. 5. Rooms, Baird Building. Secy., H. Goldmark.

American Institute of Mining Engineers.—Glen Summit, Pa., Oct. 6. Secy., R. W. Raymond, 13 Burling Slip New York.

Western Society of Engineers.—Oct. 7. Secy., J. W. Weston, 230 La Salle St., Chicago.

American Society of Civil Engineers.—Oct. 7. Secy., Francis Collingwood, 127 East 23d St., New York.

Engineers' Club of St. Louis.—Oct. 7. Secy., Arthur Thatcher, Room 801, Odd Fellows' Building.

Boston Society of Civil Engineers.—Oct. 7. Secy., S. E. Tinkham, City Hall.

Engineering Association of the Southwest.—Oct. 9. Secy., O. H. Landrett, Nashville, Tenn.

Civil Engineers' Club of Cleveland.—Oct. 9. Secy., A. H. Porter, 50 Euclid Ave.

Northwestern Track and Bridge Association.—Oct. 9. Rooms, Union Station, St. Paul.

Atlanta Society of Civil Engineers.—Oct. 13. Secy., Parker N. Black, Room 39, Capitol Block.

Denver Society of Civil Engineers.—Oct. 13. "Municipal Engineering." Secy., Geo. H. Angell.

Northwestern Society of Engineers.—Oct. 13. Rooms, Occidental Block, Seattle. Secy., E. H. Warner.

Civil Engineers' Association of Kansas.—Oct. 14. Secy., J. C. Herring, Wichita, Kan.

New England Railroad Club.—Oct. 14. Rooms, United States Hotel, Boston.

Engineers' Club of Cincinnati.—Oct. 15 Secy., J. F. Wilson.

New York Railroad Club.—Oct. 15. Rooms, Gilsey House.

Scandinavian Engineering Society of Chicago.—Oct. 15. Secy., T. G. Philfeldt, 113 Adams St.

Montana Society of Civil Engineers.—Oct. 17. Helena.

Western Railway Club.—Oct. 20. Rooms, Rookery Building, Chicago.

Engineers' Society of Western Pennsylvania.—Oct. 20. Secy., J. H. Harlow, Pittsburg, Pa.

American Street Railway Association.—Annual convention at Pittsburg, Pa., Oct. 21, 22, 23. Secy., Wm. J. Richardson, Brooklyn, N. Y.

IN the review of the paper by Mr. E. A. GIESELER, on "The Waterway between Jetties," in our issue of Aug. 29, the first equation on page 186 was wrongly given, the quantity $\sqrt{\frac{562,500}{SR}}$ having the square root symbol over the numerator alone instead of over the whole fraction as it should have been. In the application of the formula, given at the same time, the square root sign was correctly placed.

THE burning of the *Commercial Advertiser* building this week, following so closely upon the Park Place disaster, would seem to demand some radical change in our building laws and the methods of inspection and condemnation of unsafe structures used for business purposes. Here was a building with a part of it at least ante-dating the Revolution, with flimsy walls, dry, oil-soaked wooden floors and partitions, and wooden ventilating shaft particularly well adapted to spread fire thoroughly and rapidly. The unsafe condition of the building was so well recognized that insurance against fire was almost prohibitory in the rates demanded. Yet it was crowded with offices and small shops and factories and with their occupants. That but one or two lives were lost out of the crowd of employees is a happy chance, rather than the result of any precautions beyond a double set of fire-escapes. It is time that death traps of a similar description were hunted out over the whole city, and either entirely condemned and torn down or such an amount of repair demanded by the law that the result would be about the same. This is hard upon the owners, we know; but the question at issue is one involving the possible loss of human life and large interests in surrounding property on the one side, and the collecting of rental from an unsafe building, as long as the shell will hold together, on the other. It is public against private interest, and the greater interest should rule.

The fact that the pressure in the city mains was so low that an adequate supply of water could not be obtained for about 25 minutes after this fire broke out calls for stringent investigation. As yet the true cause for this want of water is not apparent, as the statement of the chief engineer of the aqueduct that it was due to the excessive use of water among consumers at that hour does not seem to hold good. The fire occurred at an hour when the heavy morning demand should have ceased, and the opening of a valve at the reservoir at once resulted in sufficient pressure. Buildings of this type should be provided with hose and hydrants of their own, or buckets of water, so disposed that a fire could be at once attacked. But if the pressure in the mains is to be reduced during the day especially, for any cause excepting sheer necessity, this precaution would be worthless. It is stated that a prompt application of water, even after the engines arrived, would have confined this fire to the room where it originated. And whether this is so or not, it is evident that the chance should not have been lost by reason of any thoughtless manipulation of valves, if the latter were the true cause of failure of pressure.

IT has been generally known for a considerable time that while the great manufacturers of electrical apparatus have been rolling up profits by the millions, the local companies furnishing electric light and power have had by no means easy sailing to make both ends meet. At two or three meetings of the National Electric Light Association, there has been some public muttering over this condition of affairs; but at the Montreal convention last week the storm broke in earnest and there were some very emphatic expressions to the effect that the owners of central station plants had served under the yoke of the manufacturers of electrical apparatus long enough. A resolution was passed that the committee on "Relations between parent and sub-companies" be instructed to formulate a definite plan of procedure for the protection of central station companies, and to prepare the necessary articles of agreement and report the same to the association at its next convention.

The complaint of the central station men is that while at the start the wily manufacturers claimed their apparatus to be wonderfully efficient and practically indestructible, and guaranteed to purchasers high efficiency and protection from competition, both through the control of patents and through the grant of exclusive rights to given territory, these claims proved to be widely misleading and the guarantees have been ignored. The patent protection was not given. The pioneer enterprises saw their field invaded by companies employing the identical devices for which they had paid high prices under the supposition that they were to have the monopoly of their use in a given district.

A second charge is that after the period of consolidation, when the strong manufacturing companies bought up their weaker rivals, some of these purchased competing systems were fortified at weak points by the parent companies; and this apparatus was sold at greatly reduced prices to parties intending to compete with the existing central station companies, which the parent companies had themselves established and to which they had guaranteed a monopoly. Thus the gas companies, which fought the electric lighting systems tooth and nail when first established, are now encouraged by the manufacturers to enter the field in competition with the pioneer companies, and are furnished with plants at greatly reduced figures. The movement toward municipal ownership and operation of electric light plants, too, is being encouraged by the manufacturers.

ACCORDING to the sentiments expressed at the Montreal meeting, the central station companies believe that they have submitted to raids from competing enterprises long enough. They propose to organize for mutual protection and enter into an agreement to purchase apparatus only of manufacturers who will agree not to sell apparatus to rivals of existing central station companies. Another proposition is for the central station companies to standardize their apparatus, subscribe capital in proportion to the capital invested in their plants, and do their own manufacturing. Already electric lighting companies representing more than twelve million dollars are said to be pledged to this latter scheme. It was stated further that the patents on nine-tenths of the machinery necessary for equipping electric lighting stations have expired and that no obstacle therefore existed in this direction.

If the warlike sentiments expressed in the convention are carried out in practice, there will be a decidedly interesting struggle between the local companies and the manufacturers. While the former can doubtless do much to defend themselves by organization, the manufacturers probably hold the stronger position. As one member put the case, doubtless with great exaggeration, "there is enough apparatus in central stations today to do all the business for 10 years to come, without buying a particle from the parent companies." There is presumably enough truth in this to make the manufacturers not so anxious to retain the custom of the existing companies as they once were. They seem to have already lost the "good will" of the local companies, and their policy will very likely be to break openly with them and encourage the formation of new competing companies, whose chances of success, owing to the reduction in the first cost of electric plant compared with the cost of that which the pioneer companies purchased, are at least fair.

While the general public will have low prices for electric service in every city where a battle of

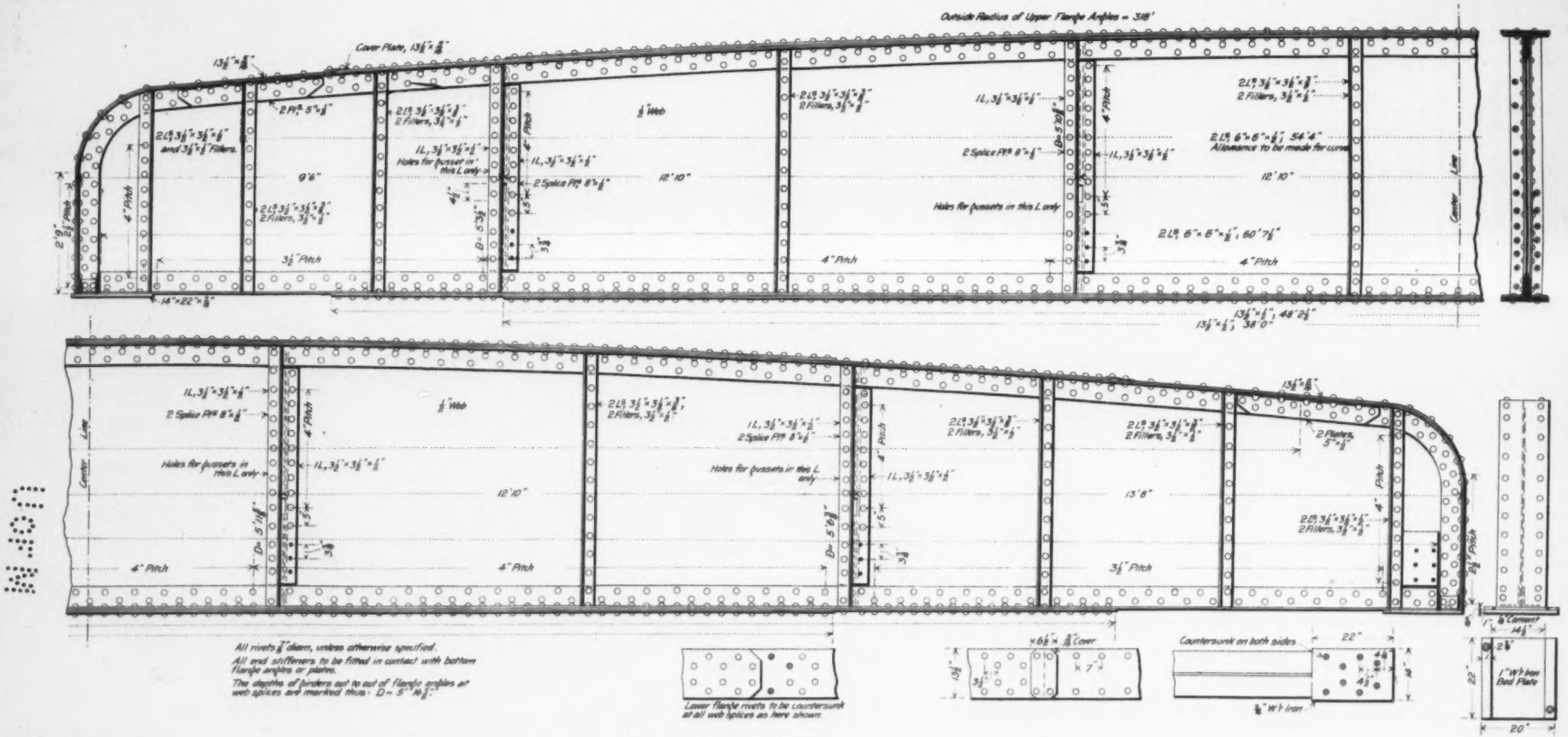
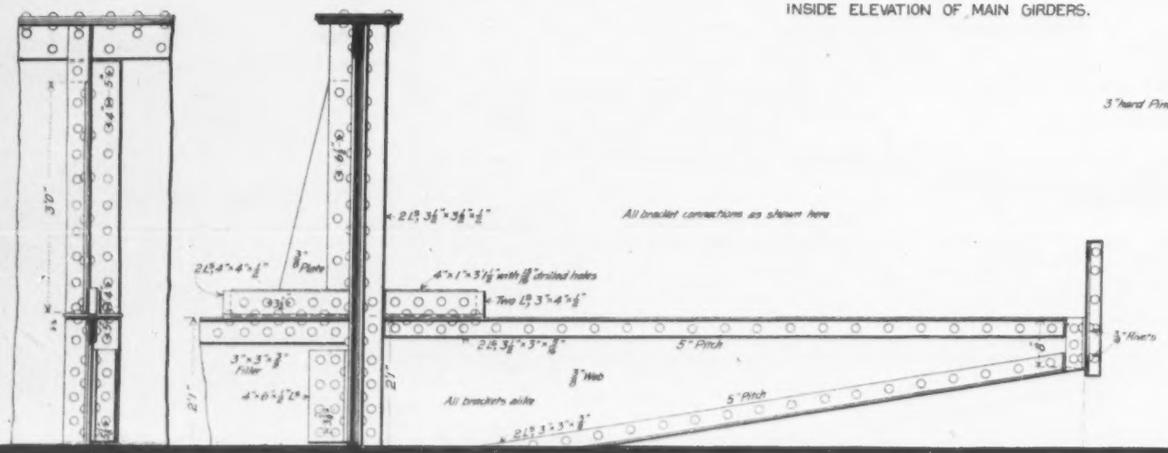

Outside Radius of Upper Flange Angles = 318'
Cover Plate, 13½" × ⅝"
Web
Center Line
4" Pitch
3½" Pitch
12'10"
9'6"
13'6"
Holes for fussets in this L only
Holes for fusset in this L only
2 Splice Plts ⅝" × ⅜"
2 Splice Plts ⅝" × ½"
2 Fillers, 3½" × ⅜"
2 Fillers, 3½" × ½"
2 Plates, ⅝" × 5"
2 Plates, 5" × ⅝"
2L's 6" × 6" × ½", 54'4"
Allowance to be made for curve
2L's 6" × 6" × ½", 60'7½"
13½" × ½", 48'2½"
13½" × ½", 38'0"
14" × 22" × ⅜"
All rivets ⅞" diam, unless otherwise specified.
All end stiffeners to be fitted in contact with bottom flange angles or plates.
The depths of girders out to out of flange angles at web splices are marked thus: D = 5' 10⅜"
Lower flange rivets to be countersunk at all web splices as here shown.
Countersunk on both sides
⅝" W'h Iron
1" W'h Iron Bed Plate
6" Cement
20"
22"

FIG. 2.
INSIDE ELEVATION OF MAIN GIRDERS.


All bracket connections as shown here
All brackets alike
2L's 3½" × 3½" × ½"
4" × 1" × 3'1½" with ⅞" drilled holes
Two L's 3" × 4" × ½"
2L's 3½" × 3" × ⅜"
3" × 3" × ⅜" Filler
⅜" Plate
⅜" Web
5" Pitch
⅞" Rivets
3'0"
2'1"

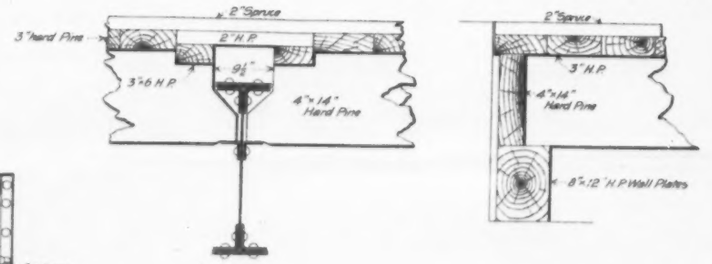


FIG. 6. ROADWAY FLOORING AT FLOORBEAMS & ABUTMENTS.

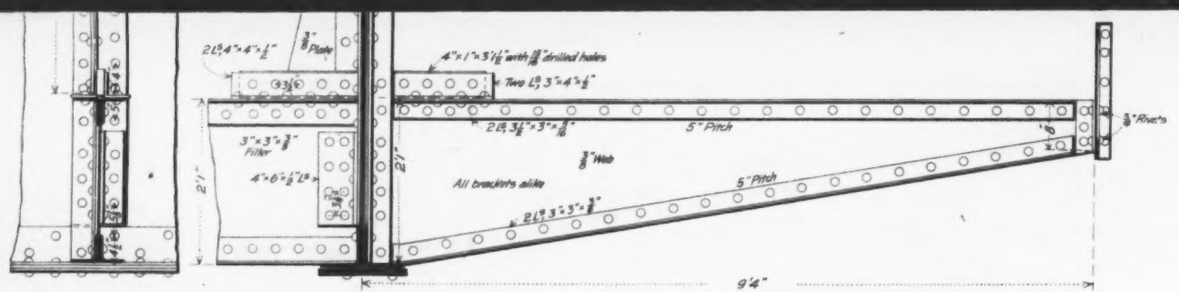
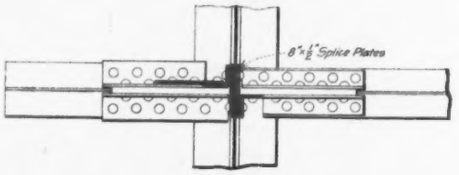
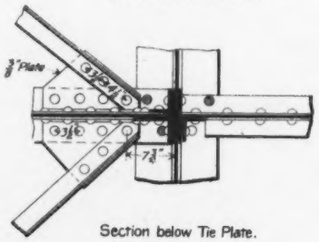


FIG. 6. ROADWAY FLOORING AT FLOORBEAMS & ABUTMENTS.



Section above Tie Plate.



Section below Tie Plate.

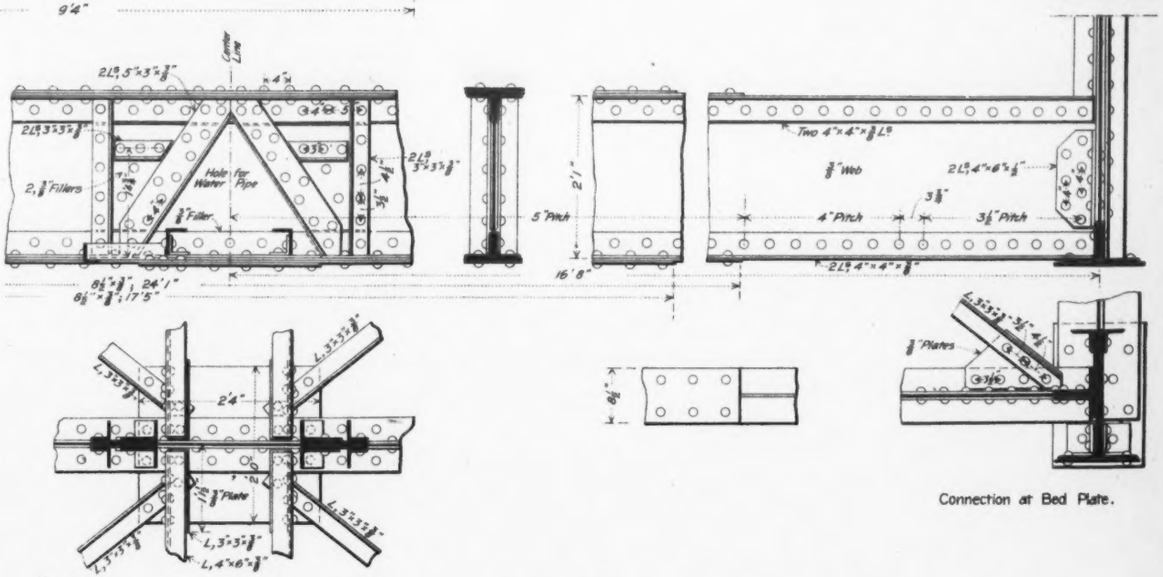
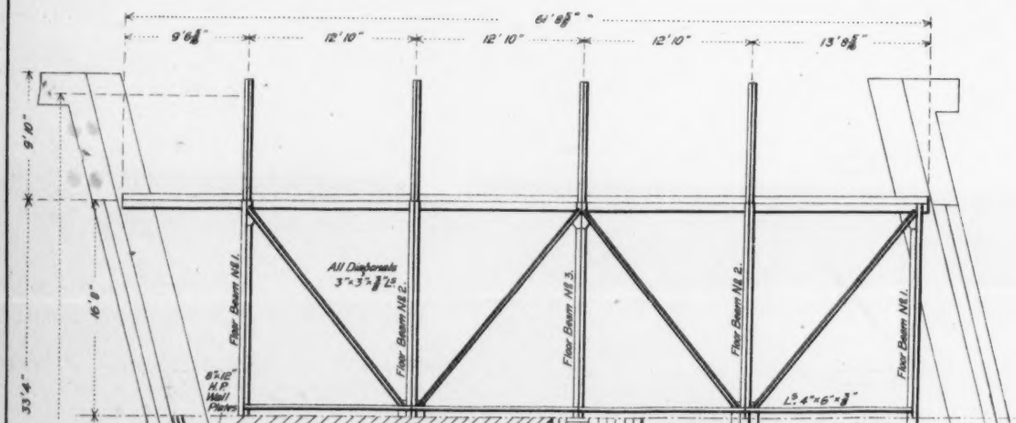


FIG. 4.
FLOOR BEAM CONNECTIONS AT WEB SPLICES.

FIG. 3.
DETAILS OF FLOOR BEAM.



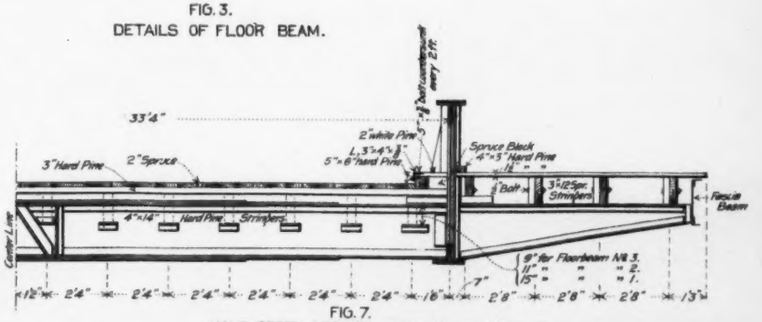
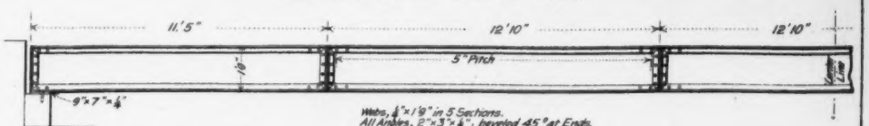


FIG. 7.
HALF CROSS SECTION SHOWING FLOOR.



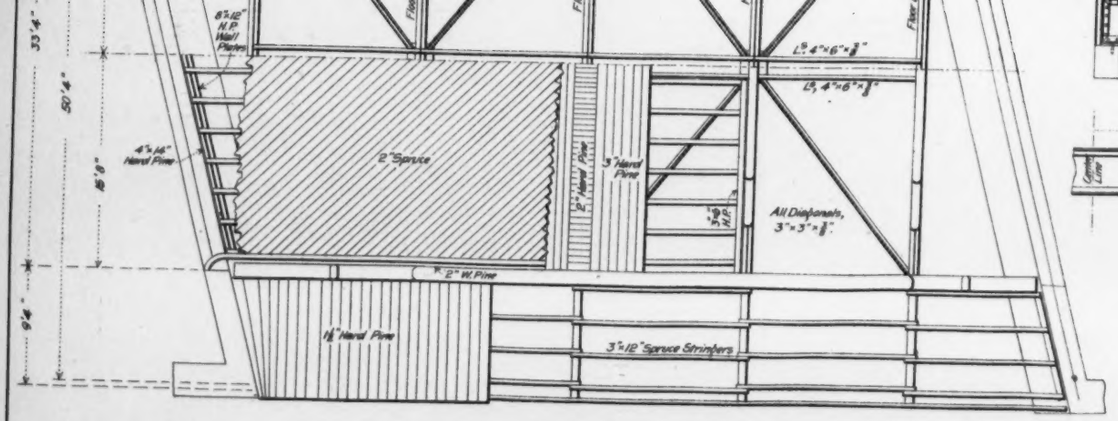


FIG. 8. PLAN OF FLOOR SYSTEM AND FLOOR.

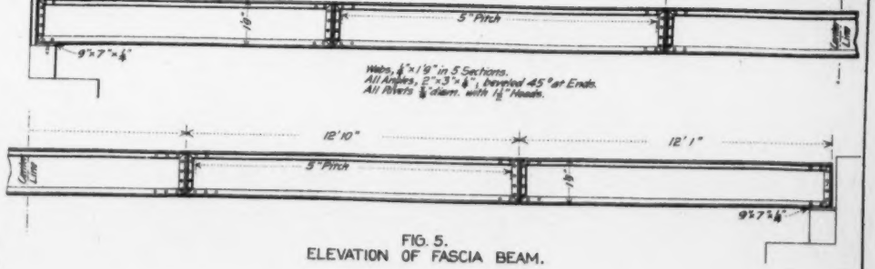


FIG. 5.
ELEVATION OF FASCIA BEAM.

PLATE GIRDER HIGHWAY BRIDGE AT BROOKLINE, MASS.

ALEXIS H. FRENCH, TOWN ENGINEER. HENRY F. BRYANT, ASSISTANT ENGINEER IN CHARGE. JOHN E. CHENEY, CONSULTING ENGINEER.

CHAS. HART & SONS, LITH. 26 VESEY ST., N. Y.

this sort is fought, in the long run the waste of capital in duplicate lines of wire, subways and central plants will be paid for in the end by the users of electric lights. The history of competition in the gas business is being repeated in electric lighting. The call for cheap gas to-day is met by the statement that the gas companies, paying interest on the cost of miles of useless duplicate mains laid by companies started to compete with the established companies, cannot afford to furnish cheap gas. So with electric lighting; when consolidation has done its work the people will be called upon to pay the interest on the money wasted in duplicate plants and lines of wire. The whole trouble arises out of the deplorable carelessness with which American cities grant franchises for the use of the public streets. Until this is changed, wasteful competition and stock inflating combinations of electric lighting companies and other corporations furnishing public service will continue.

It is authentically reported that the New York Central managers are to run a new fast express between New York City and Buffalo, which will make faster time than any regular train now running, 55 miles per hour being mentioned as the probable schedule rate without stops. The fastest train now running over this road is the New York and Chicago limited, the schedule time of which, between New York City and Buffalo, 441 miles, is 10 h. 35 min., an average rate, including stops, of 41½ miles per hour. The only stops scheduled are at Albany, Utica, Syracuse and Rochester. The stops at Albany and Syracuse are each 5 minutes long to allow a change of engines.

It is apparent from this that a new fast express cannot gain much by reducing the number of stops. Indeed, as the new train is to be called the "Fast State train," and to be intended principally for the accommodation of the travel between the principal points on the road, it ought certainly to make stops at Fishkill, Poughkeepsie, Rome, Newark and Batavia in addition to the above. If a gain is to be made over the time of the present fast trains, then, it must be done by increasing considerably the running speed.

To a certain extent this can be done without increasing materially the maximum rate of speed on the open road. It goes without saying that the new train will be considerably lighter than the heavy through express trains. It will have to be if the locomotive is to keep up to a much better schedule than that now in force. A lighter train can be got under headway more quickly, and each stop and each slackening of speed will be less potent as a cause of delay. But all the saving which can be made in this way will not give a running time of 55 miles per hour within a good deal; such a speed, if attained, must be reached by running at over 60 miles an hour on the open road, and probably by running at a high speed through the small cities and towns along the line.

If along with the announcement of this train would come the statement that the block system of operating trains was to be adopted for the whole line of the New York Central this scheme might be regarded with more favor. As things are, however, it is risking quite enough to run trains over the line at 41½ miles per hour with nothing but a time interval and a sleepy brakeman to prevent rear collisions. For the safe running of a fast railway train there are many things necessary. Roadbed, track and rolling stock must be in proper condition and employees of every class must be efficient and faithful. But with these things ever so well secured, a weak link in the system of operating may cause disaster, and does cause it every week in many serious accidents.

Vice-President Webb is quoted as saying that last Monday's fast run with a special, "practically demonstrates that an ordinary passenger train can be run over our road comfortably and safely at a higher rate of speed than has yet been maintained in passenger traffic." Whether the reporter correctly quoted him or not, we do not know, but it demonstrates nothing of the sort. Because on a pleasant day in the fall a special train train was run at an average of over 60 miles an hour for 440 miles, with no other mishap than a hot box, it does not follow that the general speed of passenger trains, which run every day in the year, in wind, snow, fog and rain can be safely increased, especially when the system of train operation is such as to invite collisions when trains run irregularly.

The streets of New York are dirty, shockingly so, and the Commissioner of Street Cleaning has been summarily removed and practically without a hearing. Just where the blame comes in we cannot say, nor how much politics has to do with the removal, but the fact remains that after $964,684.-91, out of an annual appropriation of $1 511,250, has been expended the streets are dirtier than for some time past and loud complaints are made regarding the delay in removing ashes and garbage. The present condition of Broadway is chargeable to the change now in progress from horse railway to cable traction, under almost phenomenal conditions of construction, due to the mass of pipes and conduits placed without semblance of order under the surface of that street. Great as is the disorder, the dirt and the annoyance to traffic and business resulting from this change of systems, it is only a natural consequence of previous neglect and want of system in providing for a network of underground street gear that has grown to almost unmanageable proportions in the last few years. Clean streets mean well paved streets; but even the great City of New York cannot afford to build streets that are liable to be constantly broken up, as is now the rule here. But it does seem that the dearly bought experience of the immediate past and present should bear some fruit in the form of plans for at least reducing the constant waste of public funds and energy now necessary. Any system for gathering together pipes and conduits in subways will cost a great deal of money and take time to construct; but, on the other hand, we are now wasting the same money that properly applied would give us well paved and easily cleaned streets in simply doing work that may be, and often is, undone within a week. Our present treatment of the street paving, street cleaning and pipe and wire disposal problem can only be likened to dipping up water with a sieve; it costs money, labor and patience, but the result is practically nil. In the present controversy with Commissioner Beattie regarding street cleaning, the fault doubtless lies more in the lack of system in street paving and the maintenance of an unbroken street surface, than in any special failure in the administration of his office as Commissioner of Street Cleaning.

We find in one of the railway trainmen's journals, a letter making a rather serious charge against some of the dressed beef shippers who own refrigerator cars. The writer claimed to have helped to handle many of these heavy dressed-meat express trains on which the air-brake hose had been taken off and hung inside the cars to prevent the use of the brake. The reason given was that when these cars were run at the head of a train with band braked cars in the rear, the shocks from application of the brakes would jar down some of the meat. He also states that as the brakes are double connected (on both trucks) and very stiff in their action, it is almost impossible to make them hold well with the hand brake-gear, and the cars are therefore hard to stop.

We cannot vouch, of course, for the truth of this charge, but it is a matter worth inquiring into. There are still many refrigerator cars in service not equipped with air brakes; but the Ravenna disaster has pretty well impressed upon railway men the necessity of requiring the equipment with air brakes of all cars to be run in express freight trains. It will take a little time to accomplish this, but meanwhile the refrigerator cars which have airbrakes should be doing their full duty. Shocks in train service with air brake cars bunched next to the engine can be largely avoided by careful engineers; and, in any case, it would seem that the shocks in switching and making up trains probably do more to jar down the quarters of beef than the shocks due to the applications of brakes. To put the air brakes out of service for the reason above stated seems a penny wise and pound foolish policy. If the dressed beef shippers are practising it, it is probably because they appreciate the fact that they save the pennies while the railways risk the pounds.

Technical Training vs. Self-Tuition Among Engineers.

Every now and then some young man seeking a vocation in life asks us whether or not we would recommend a thorough training at a technical school as a necessary preliminary to entering some one of the many branches of engineering. Many ingenious arguments are advanced in favor of combining study with practice in the field or work shop, and many names famous in the annals of engineering are quoted as belonging to men who have literally risen from the ranks, men like the elder Stephenson, Telford and Smeaton and the bulk of American civil engineers connected with the infancy of engineering in the United States. It is argued that study combined with experience is more efficient, and that facts gathered in practice teach more than dull books conned in a schoolroom.

In answer to the query above, we most emphatically recommend the most thorough scientific and general education at the best technical school available as an absolutely necessary preliminary step to successful practice in any branch of engineering. The time has passed for self-teaching, and Stephensons, Telfords and Smeatons are rare in this day. Some young men, by reason of natural qualifications, untiring labor and personal chance or opportunity, may succeed in spite of the lacking early technical training. But these same men would have advanced more rapidly and risen higher had they had the opportunities referred to. The modern science of engineering is too broad, its detail too intricate and its progress too rapid for the untrained mind to keep pace with it; and education in those who adopt engineering as a profession is so general and the schools are now so well equipped in teachers and apparatus, that even a phenomenally bright young man who starts out without these advantages will find himself sorely handicapped in the race for preferment. He may succeed, and some do succeed, but it is uphill work and a waste of useful energy.

Engineering is a many-sided profession, in the first place, and is utterly unlike its elder professional brothers in this respect. It enters in some of its many branches into our very life; it means modern progress in the world, and without it civilization would stop. Engineers—not divines, lawyers or doctors—are entitled practically to all the credit for the phenomenal material advance made in the civilized world in the last century, or even in the last half century, that spans an era of development far surpassing in its scientific achievements any equal period in the world's history. It is the engineer—civil, mechanical, hydraulic, sanitary, mining or electrical—that has created our railways and canals, built our steamships and battle-ships, brings wholesome water to our doors, and sets thousands of spindles whirring by water power; builds, drains and paves our cities; improves the homes of rich and poor; turns our

metals into finished products, and sets space and time at defiance, and lights our cities and carries their people by the power derived from the electrical current. In fact, it is hard to say what an engineer is not, or what he may not be called upon to do.

Under these conditions it is naturally very difficult for either the young man, or his parents, to decide which of the many distinct paths of engineering it is best for him to enter; in which one he would be most likely to succeed. It is just here that the technical school, as now organized, has its real value, as an indicator of the best course to pursue. It is true that some of these schools are intended to train men for special branches of engineering, civil, mechanical, electrical, etc.; but as a rule the earlier courses of these institutions have for their purpose the development of the natural endowments, and do this by a general course of scientific training that is common to all branches of the profession, and essential as a foundation for any special branch. The work shop, the laboratory and practice in the field now go hand in hand with theoretical teaching, and if the student has any natural inclination toward any special field of applied science, the fact is soon made evident to himself and to his teachers. With the direction once pointed out, it is then easy to find and follow to any end the path in life for which he is best fitted, and in which the student and the man is most likely to succeed. To-day there are schools for the advanced student in any one of the special branches of engineering that he may select, and the amount of knowledge gained before he commences to practice depends purely upon his own mental capacity and power for work.

But, say some young men, all this higher education costs money and we have not got it. Then our honest advice is, seek some other field of work where a technical training is not necessary. There are altogether too many self-taught engineers in the field now in this country and in every section of the United States evidence can be found of their honestly intended but faulty work. Any young man can enter an engineer corps, learn to drive stakes, pull a chain and run a level or transit in time. By force of circumstances, opportunity or personal influence among the controlling spirits of a corporation, he may finally succeed to a position of some responsibility, and he then usually assumes that he is a full fledged civil engineer. So he is as far as the duties we have first enumerated are concerned, and he may do all of these well. But this is not civil engineering; it is scarcely worthy of being called the A B C of the art. TELFORD defines engineering as "the art of directing the great sources of power in nature for the use and convenience of man." To realize this definition the engineer must be well trained, he must know what other engineers have done, be mentally equipped so that he can follow their line of reasoning, profit by their experience, and be enabled to think and to plan for himself. He must know many things and know them well, and to obtain this information the technical school, with its trained and experienced staff of teachers, its laboratories, its work shops and its facilities for experiment and original research is essential.

Engineering is a profession of emergencies; the unexpected thing is always turning up and the engineer must be ready to meet them, and to meet them at once. He is often so situated that the best library of reference obtainable with money is of no avail, for it is inaccessible when wanted and time to consult it is lacking. Vast interests or human life may depend upon what work he performs within a few hours, and to perform this work he must first know what to do and how to do it. It may be that he meets a difficulty that is unique in its way, or, if it has happened to other engineers, the methods pursued are unrecorded. But if he is well grounded in the leading principles of his profession, has a broad grasp on the field of engineering knowledge, has gained wisdom by the emergency experience of other engineers, even in other fields, and above all is sure of himself, he will quickly devise some way out of the scrape and gain renown and advancement for himself—though this latter does not always follow in this selfish age.

The timid engineer, who has no capital but the scanty knowledge he has picked up in the intervals of a busy life, may attempt to do something under these circumstances of danger, and he may possess sufficient force of character to put his plans into execution. But he usually does the wrong thing, commences at the wrong end, puts his props in the wrong place and generally bungles. And when he has time to hunt up authorities he appropriates a formula without understanding its limitations or controlling conditions, and builds upon a foundation of mental sand, so to speak, and is professionally a failure. It is true that some one else usually pays for his blunders; but as long as the employers of engineers are short sighted enough to intrust their work to the cheapest man who styles himself an engineer, we certainly can not say that we are sorry for them. Corporations themselves are to-day mainly responsible for any bad work performed on their properties, for the reason that to day competent, trained and experienced engineers can always be secured if the employer makes the attempt to seek them out and has the wisdom to pay for the best talent the work in question will demand. In brief, the real engineer of modern times, to whatever branch of the profession he may belong, is not born an engineer, nor does as he grow, as Topsy grew, to be an engineer. He must be made; and, like any other good machine, the finer the original material, the more perfect the workmanship and the more care used in adapting all the parts to the duty to be performed, the more certain and satisfactory will be the results obtained.

While we are on this subject it might be said that there are some other qualifications besides a technical training that are necessary to make an engineer, and especially a civil, mechanical or mining engineer. He must, first of all, be a sound, active man, physically and mentally. A man equipped with all the learning the schools can give him, but bodily weak, has little of a future before him if he selects civil engineering as a profession. Just as the civil engineer is expected to do almost anything, so he must be ready to go anywhere, from the top of Pike's Peak, with its snow and ice, to the swamps of Central or South America. Even in the United States he must be out in all manner of weather and rough it generally. His digestion must be good, his lungs sound and his legs strong. In the actual practice of the profession there is no room for physically weak men; and while a finished education may enable a man to teach to some extent, he is not a teacher in the proper sense of the work unless he can leaven his teaching with the precious wisdom gained only by experience.

An engineer must have also plenty of physical and mental courage or pluck, in the better sense of that word. In an emergency he must not only be able to plan and tell others how to act, but he is the natural leader, and must often act himself under circumstances where there may be danger to life or limb. We have personal knowledge of one case where a crippled shaft was to be rebuilt; it was dangerous work, and the men well knew the danger. But they had faith in their engineer, and as long as he would come down among them once or twice a day and watch their progress and the working of the timbers, they were satisfied and performed their duty and the shaft was saved. In this case there was no real necessity for the presence of the engineer, and it may be said that he was not paid for this, and was a fool to risk his life. But he had the moral courage to encounter danger for the purpose of saving work with which he was intrusted; and engineers are continually taking similar risks throughout the world.

As we have once before mentioned the engineer must possess tact; and without being servile or tyrannical, so accommodate himself to circumstances and surroundings that he will cause the least friction between himself and his employers or those under his command. Aside from the fact that the exercise of this quality will make his life easier, is the more important result of keeping his employers well disposed toward him, and the ability to obtain from his employees the maximum of work with the minimum of effort. Workmen are men too; and if they are justly and firmly, but kindly treated, and beyond this respect their engineer for his mental and personal qualities, they can and will help their master out of many a scrape. The greatest mistake an engineer can make is to put himself upon too lofty a pedestal of superior rank to his staff and to his working force. He must be among them, and one of them, both ready to grant reasonable favors and ready with aid from his wider experience. But he must be firm where firmness is necessary, and maintain strict discipline when work is to be done.

But while the young engineer should be well educated and well trained, strong of limb, full of energy, brave and just, it is yet proper to say that the possession of all this training, combined with the other qualities, does not necessarily make an engineer. He must add to this years of hard, practical experience and always remember that there is no royal road to success in his chosen profession. Many young men who have carried off the prizes of their college course and have graduated with all the honors, forget this and at first feel disappointed because they are barred out from the higher walks in their branch of science. But if the right stuff is in them they soon recover and realize the fact that technical schools do not turn out engineers, but only young men more or less thoroughly equipped for rapidly gaining the practical knowledge that is only obtained outside of schools. What they have gained in the schools is the ability to better think for themselves and better appreciate and weigh the experience that must come later, and this ability is worth all the time and hard work it has cost. Work alone makes the really great engineer; but if a man has to waste his time in picking up in twenty years or more of self-tuition what he might have gained in a four or five years' course of technical training, when his brain was yet young and receptive, he will rarely pass beyond the middle stage of professional rank.

CORRESPONDENCE.

Ascertaining the True Meridian.

UNITED STATES COAST AND GEODETIC SURVEY,
WASHINGTON, D. C., Sept. 11, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: In your issue of Sept. 5, 1891, there appear two articles bearing on the subject of ascertaining the true meridian, and which contain references to two bureaus of the general government.

The first article, p. 206, headed: "Method of simultaneous culmination of Polaris with Alioth and adjacent stars in the handle of the Big Dipper," states that the "Manual of the Surveying Instructions for the Survey of Public Lands" retains the old diagram (referring to the star Alioth) without any change; it will be seen, however, that the latest edition of the manual (Jan. 1, 1890) substitutes the star Mizar as now to be used.

The writer of the second article (p 217) calls the attention of the Coast and Geodetic Survey to the subject with a view of securing further aid for the surveyor. He may be referred to Appendix 8, Coast and Geodetic Survey Report for 1881, which gives the method with an example for directly determining an azimuth at any time by observation of sun or star, and to Bulletin No. 14 (Nov. 21, 1889). Copies of these publications can be had on application to the superintendent.

The special facilities the second writer desires, he will

find in the manual issued by the Commissioner of the General Land Office, Washington, 1890, supplemented by the tables (pp. 84, 85). These tables are reprinted in Johnson's "Theory and Practice of Surveying," seventh edition, New York, 1891.

CHAS. A. SCHOTT,
Assistant U. S. Coast and Geodetic Survey.

The Laying Out of Towns.

SCOTTDALE, Pa., Sept. 11, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: The letter from Mr W. H. Dorsey in your issue of Aug. 29, on "The Laying out of Towns," presents the subject in a very concise and definite way. It is a subject that I think would bear considerable discussion by engineers who have made this a specialty, and one on which but little of real value seems to have been written.

A most remarkable method of laying out town property came to my notice in an Arkansas town some time ago. The topography was so precipitous, the place being located in a deep valley, that all the principal streets were laid out in the general direction of the contours, intersecting at acute angles. As there appeared to be no attempt at regularity, this much was probably the result of a natural growth of the town. But the remarkable feature was in the subdivision into lots, *each lot being 40 ft. square*, where there was room between the streets, and if these were more than 80 ft. (!) apart the portion between the street lots had no frontage! KENNETH ALLEN.

Steel Foundations.

JACKSON, Mich., Aug. 11, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: In your issue of the 8th I notice a valuable and eminently practical article on Steel Foundations, by Mr. CONGDON T. PURDY. I think that the method of constructing foundations therein described is, without doubt, the best possible for certain conditions of the underlying soil. There may exist conditions under which a pile foundation would be superior, but there are also conditions under which this foundation is certainly superior to a pile foundation.

I do not wish, however, to discuss the merits of the method or materials, but simply to call attention to what seems to be a serious omission in the calculations. Mr. PURDY gives a very neat and simple formula for the moment, but, unfortunately, overlooks one very important application of it. We will take the case given in his article, and turn our attention to the calculations of the second and fourth courses, in which the beams are parallel and act in the same direction. For the sake of brevity, we will omit the calculations of the first and third courses, they having no particular influence upon the calculations of the second and fourth courses as beams, being perpendicular to them.

The fourth or top course consists of nine 15-in. I-beams, supporting at the center a cast base 5 ft. square, the I-beams having an aggregate moment of resistance of 1,059,300 ft. lbs. The load on the column is 1,165,000 lbs., and by means of his formula, taking moments on one side of the column around the edge of the cast base, Mr. PURDY finds that the beams may project 5 ft. 4 ins. on each side of the base, which is certainly correct principle.

The projection of the second course beyond the ends of the fourth course is known, being determined by the area of clay to be covered by the foundation. It is 2 ft. 10 ins., and by taking moments around the end of the fourth course, using the formula again and substituting the proper values, a bending moment of 225,780 ft. lbs. is obtained. This is resisted by 19 rails having an aggregate moment of resistance of 229,900 ft. lbs., which gives quite a margin on the side of safety.

Now, omitting entirely the weight of the beams, there is a pressure of 1,165,000 pounds supposed to be evenly distributed (longitudinally, at least) along the under side of this second course. This evidently must be true if the object of the foundation be obtained. We will take the moment of the proper portion of this pressure around the edge of the cast base (or a point vertically below it) and apply Mr. PURDY'S formula, $M = \frac{l\,y}{2y+a} \times \frac{y}{2}$. In this case $a = 5$, $y = 5\frac{1}{6} + 2\frac{1}{2} = 8\frac{1}{3}$, and, omitting weight of beams, $l = 1{,}165{,}000$. Substituting these values, $M = \frac{1{,}165{,}000 \times 8\frac{1}{3} \times 4\frac{1}{12}}{(2 \times 8\frac{1}{3}) + 5)} = 1{,}822{,}650$.

This moment is resisted by the combined moments of resistance of the 9 15-in. I-beams and the 19 tee rails, $= 1{,}059{,}300 + 229{,}900 = 1{,}289{,}200$ ft. lbs., giving an excess of the actual bending moment over the moment of resistance of 533,400 ft. lbs., or about 41 per cent.

This is simply an oversight, but that it is an oversight of no small importance will, I think, be freely admitted.

For the resisting values of the material used I have simply taken those given by Mr. PURDY, and have taken all figures made by him as correct, so far as they apply, without checking.

I presume a similar excess of load (or discrepancy of material, as you please) may be found in the first and third courses, but as the object of this communication is to call attention to the principles of the calculations rather than any criticism of the results, I have given sufficient.

I much regret this oversight in what was really an able and well written article. I especially regret that the oversight occurred in the calculations of a portion of the foundation actually constructed for one of the largest buildings in Chicago. Having noticed it, it becomes my simple duty to call attention to it.

Taking the working strains given, 20,000 lbs. for the I-beams and 16,000 for the rails, and increasing by 41 4 10%, gives about 28,300 for beams and 22,600 for rails, which for steel under a quiescent load is perhaps not really alarming, but it is approaching dangerous territory.

BENJ. F. LA RUE.

[We have received several letters criticising the load distribution and moments of resistance to bending, as laid down in Mr. PURDY'S communication on "Steel Foundations." These other letters, however, are practically the same as that of Mr. LA RUE, here published. In the press of business Mr. PURDY has not found time to answer in detail the objections raised, but from his letter we gather the following, as explaining the position taken by him in his article: Mr PURDY says that the criticism is just, and that there is no question but that the total moment of resistance of the beams of the several parallel layers of iron of a foundation, taken separately, and as he has calculated them, is less than the opposed bending moment of the foundation taken as a whole. But he has not attempted to provide for this moment, and the designers have not deemed it necessary. This very question, says Mr. PURDY, has been frequently discussed among the engineers, and led by motives of economy and a study of the behavior of similar foundations already under maximum loads, they have arrived at the following conclusions: That if there were no concrete, and if the load really rested upon water, with the bearings of the beams one on the other, all well oiled, this moment would have to be provided for. But as a matter of fact the concrete acts to some extent as a beam, the earth itself does not change position like water, and consequently the binding effect of the iron and concrete, taken together, causes the foundation as a whole to have a moment of resistance much larger than the sum of the resistances of the several layers. Mr. PURDY admits that this is not easy to demonstrate in figures, and that he erred in his original article in not having referred to this factor of practical experience. He is still open to conviction and says that if the Chicago engineers are wrong it is time that the fact was known. But a number of foundations are now in based on a similar line of reasoning and none yet have failed in the least degree that he has heard of. It is commercially important to save the iron if it can be done safely, and practice seems to warrant the saving.—ED. ENG. NEWS.]

The Heath Rail Joint.

The accompanying cuts represent the Heath rail-joint, which was recommended for trial by the Committee on New Joints at the recent meeting of the American Roadmasters' Association as noted elsewhere. The joint consists of a malleable iron girder suspended at the ends by joint ties placed 12 ins. apart, thus forming a bridge for the support and fastening of the rail ends between its tie supports which serve as abutments to the girder. The bed plate is given sufficient camber to distribute the weight of the rolling load to the joint ties, by which means the two ties are made to act together, thereby adding to the stability of the joints. It is claimed that by thus distributing the weight over both ties the rocking tendency of the joint is prevented, as well as the vertical action of the rail ends which is induced by the rolling load when passing from tie to tie of an ordinary suspended joint. The camber in the rail seat obviates the contact of the sharp edges of the ends of bed plate with the bottom of rail flanges, thus preventing the wear of rail base, and the anvil pound and consequent destruction of rails which are experienced with some of the ordinary forms of supported rail chairs.

To secure a maximum flexibility and strength with a minimum of material and cost, the web of the girder is carried both below and above the base of the rail or bed plate of the joint. The portion of the girder projected above the bed plate is made to rest against the side of the rail head and constitutes a rail brace to reinforce the rail ends and to stiffen them against the lateral strains and oscillations due to moving train. The bed plate portion of the joint is of channel form so as to closely fit the rail base and thereby afford lateral strength for the preservation of correct alinement and gage.

The rails are fastened by clips which hold the rail flanges. These are securely bolted together, the bolts passing under the bed plate, and being free from contact with the rails. Bolt holes in the web of the rail are rendered unnecessary and an element of weakness is thereby removed. To obviate the creeping of rails, lugs are cast in the bed plate of the joint to engage with notches in the flanges of the rails. It is stated that in tests and trials already made the joints have developed no weakness but have shown the elements of strength and security.

SECTION AND ELEVATION OF HEATH RAIL JOINT.

By supporting the rail ends on the cambered girder bed plates, the pounding and permanent set of rail ends so often seen with angle bars, are said to be avoided, and by preserving the flexibility of the joints, the splitting and lamination due to rigid supports is prevented, while the fastening of the ends of the rail flanges by bolted clips, causes the rail ends to act together, and the motion due to moving loads is continued from rail to rail in a greater degree than with other forms of joint. The joint permits free contraction and expansion of the rail.

In the distribution of metal the truss webs may be made to give such vertical strength and stiffness as the size of rail and character of traffic may require. This device is to be manufactured and sold in the states east of the Mississippi River, by Frank Bakeman & Co., of Chicago, Ill., and in the states west of the Mississippi River, by the Heath Rail Joint Co., of Minneapolis, Minn.

The Best Methods of Preserving Crossties.*

There are annually consumed over 73,000,000 cross-ties on the railways of the United States. The present rate of consumption of cross-ties is double the rate of possible production on the present timber areas. Aside from this, large numbers of crossties are annually exported to Central and South American points. An annual expenditure of over thirty million of dollars should stimulate our best energies toward the adoption of methods that will prolong the life of ties.

As shown in my former report [ENG. NEWS, Sept. 20, 1890.], the process of creosoting undoubtedly accomplishes that end; but the expense of the process is so great that very few railways care to undertake it.

In my last report I called attention to the process of vulcanizing, as used on the Manhattan Elevated Ry., and to the Wellhouse zinc tannin process as used on the Atchison, Topeka & Sante Fé Railroad. Both of these processes were and still are tentative, and it will require several years experimenting to determine their value though it is said that the latter process has practically doubled the life of crossties. The A. T. & S. F. R. R. has dropped the tannin and glue, and is using solely the zinc chloride. I regret that I have not been able to obtain the reason for this change.

I note that the Delaware & Hudson Canal Co. is about

* A paper by H. W. REED, Roadmaster Savannah, Florida & Western Ry., read at the Minneapolis Convention of the Roadmasters' Association of America.

to make a test of about one mile of track with ties treated with the zinc-tannin process, and one mile with the vulcanizing process. This test, if made thoroughly, will in time yield valuable results and should be watched with interest.

Under the head of preservation of crossties, might properly come, also, the subject of substitution of material for crossties. Steel ties have been tested in this country on a few railways, but have not given satisfaction for the reason that to make them sufficiently cheap to become a reasonable substitute for wood, they have to be made so light as to be wanting in stability. In the Argentine Republic and many other countries, iron and steel ties are used quite generally; but in this country it will be many years before any but timber ties can be considered seriously.

There are several methods of preserving the life of ties, other than the use of chemical preservative agents or substitution of materials that come practically within the scope of a road master's privilege and which I will undertake to mention briefly:

1. *Select the most durable timber.* In reply to a circular addressed to various railways I have the following information on the life of various woods.

Name of road.	Kind of wood.	Ordinary life.	Remarks.
Dela. & Huds. Canal Co....	White oak..	7 to 12 years.	
	Chestnut....	5 to 10 years.	
B., C. R. & N. R. R.....	White oak	Average 8¾ years.	
	White cedar		
Flint & P. M. Ry.....	Hemlock....	5 years.	
	White oak..	8 to 9 years.	
	Cedar.....	8 to 10 years.	Should have tie plates.
Ala. Midland Ry.....	Yellow pine...	5 to 6 years.	
Chic. & Alton.	Oak.....	8 years.	
	Cedar.....	6 years.	
Penn. R. R....	White oak..	5 to 6 years.	
	Rock oak....	5 to 6 years.	
L. S. & M. S. Ry.....	White oak..	6 years.	
	Cedar.....	.....	Depends upon wear.
Lehigh Valley Ry.....	White and red oak ...	8 years.	
	Yellow pine.	7 "	
	Cypress.....	8 "	
	Chestnut....	8 "	
Mich. Cent. Ry.....	Oak.....	6 to 9 years.	
	Hemlock....	4 years.	
	Tamarack..	4 "	
	Cedar.....	6 to 9 years.	
L. & N. Ry....	Oak.....	7 to 8 years.	Further south, shorter the life.
C., B. & Q. Ry.....	Yellow pine	5 to 7 "	
	Oak and cedar	8 years.	
B. & O. Ry....	Oak.....	8 years.	
D. & R. G. Ry.	Yellow pine.	5 years.	
	Red spruce..	6 years.	

From this table we have:

Species.	Average life.
Oak	8 years.
Black cypress	8 years, cut or wear out before decaying.
Chestnut	7½ years.
Cedar	7 years, cut or wear out, etc.
Yellow pine	6 years.
Red spruce	6 years.
Hemlock	4½ years.
Tamarack	4 years.

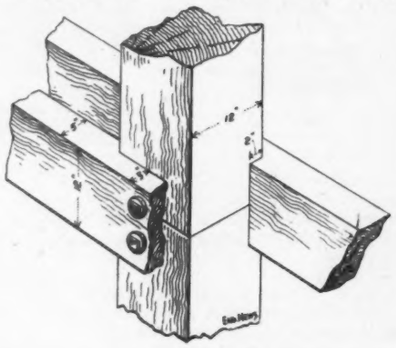
Thus oak is undoubtedly the wood most suitable for tie timber, and it furnishes 60% of the ties used in this country. Pine furnishes 20% of our ties; cedar, 6%; chestnut, 5%; hemlock and tamarack, 3%; redwood, 3%; cypress, 2%; various woods, 1%.

There are two elements of durability in ties: 1. Resistance to decay. 2. Resistance to wear.

Oak combines both qualities in the highest degree. Yellow pine resists wear but not decay. Red cedar and black cypress resist decay but are too soft. Therefore, to secure the best results from the use of cedar or cypress, a hard plate of wood, steel, or iron must be placed immediately under the rail; such plates are manufactured in quantities to meet all demands, and will be the means of bringing into use large quantities of black cypress crossties, of which the South has an abundant supply. These ties, with suitable tie plates, should last at least 12 years. The tie plates, however, should be made to cover the full width of the tie and possess 50% more bearing surface than the base of the rail, with sufficient stiffness to prevent springing; they can thus be used repeatedly and the extra first cost will be compensated for by increased service. Yellow pine is sufficiently hard to resist wear for 10 or 12 years; but as it decays in six years, any process that will successfully resist decay without adding greatly to the expense will be valuable. Vulcanizing appears in theory to meet the requirements. Three to five cents is stated as the additional cost per tie, for this process. Thus when the more costly (though perhaps more economical, method of creosoting is rejected, vulcanizing, at least with the yellow pine, may prove a valuable substitute.

The process of vulcanizing may be briefly described as follows: The timber is subjected to dry air heated to about 500° Fahr. under pressure of about 150 lbs. per sq. in., "heat and pressure being regulated according to the nature of the timber and the results to be obtained." The theory of the process is that pressure and heat produce such changes in the chemical constitution of the sap as to render it incapable of sustaining fungus growth, which fungus is the cause of decay. One of the results of the process is to harden the fibres of the wood, which is a valuable feature.

2. *Give Proper Attention to the Specifications for and Inspection of Ties.*—Every company has its specifications for crossties, more or less rigid according to local requirements. These vary from 6 ins. to 8 ins. in thickness, 7 ins. to 12 ins. in width, and 8 ft. to 9 ft. in length, for standard gage roads. Specifications generally require a certain width of heart, freedom from wind shakes, rots, hollows and splits; also, that faces shall be smooth, free from bark, etc. It is customary to allow slight variations from the specifications as to dimensions, as some will run over and others under the exact requirements. Tie contractors take advantage of this variation as far as they can, and the inspector must exercise great firmness, as well as an unusual amount of good judgment in receiving ties. In no case should physical imperfections be permitted; ties with bark on the edges, and those cut with a wind or crooked, or with a deficiency of heart on any face, should be summarily rejected. Reasonable uniformity of dimensions should also be insisted upon, as every roadmaster knows the error of placing a narrow or short tie alongside of a broad or long one. In other words, a



Joint for Trestle Post.

close and rigid inspection will often save a year in the average life of ties on a road.

3. *Ties Should not be Cut When Sap is Flowing Freely.*—As a result of some careful experiments with yellow pine ties cut in every month of the years 1884 and 1885, I have found that ties cut in January, February and June (in south Georgia) show at least 20% longer life than those cut in other months of the year. There is also an apparent advantage of about 15% in ties cut between February and June. I think, therefore, that yellow pine ties, to get the best durability, should not be cut between February and June when the spring sap is flowing. This also probably applies to other woods.

4. *Ties Should be Properly Seasoned Before Being Used.*—This is a self-evident proposition coming within the scope of nearly every man's experience or observation, and scarcely needs demonstration. The drying out of the fermentable sap prevents the growth of fungus germs, and increases the life of timber considerably. Ties can be best seasoned by piling so that a free circulation of air can be maintained through and around them.

5. *Proper Drainage of the Roadbed will Increase the Life of Ties.*—If kept well tamped up and placed in good porous ballast, ties will last much longer than on poorly-drained soil. In some sandy soils, however, ties frequently decay much faster than in clay soil. This is an apparent exception to the general rule I have stated, and is explained as follows: Warmth, air and moisture are necessary for fermentation; these are all present in the firm compact, sandy soil frequently found in all parts of the country, but with clay, air and warmth are practically excluded.

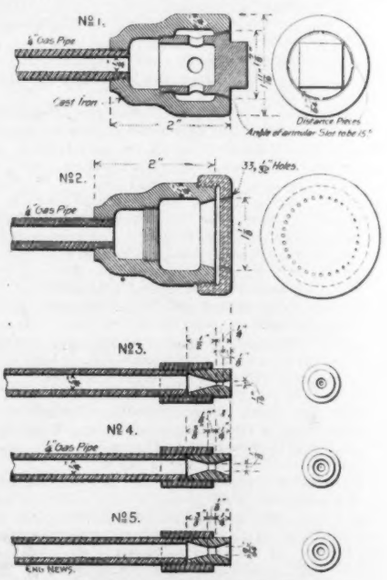
6. *Proper Care of Ties.*—The practice of using picks to pull ties into place is destructive of their life, for the pick not only makes holes that admit water into the ties, but often splits the tie, thus providing an avenue for its rapid destruction. Tie hooks are much better than picks for placing ties. Old spike holes also are a prolific cause of decay, and should be plugged with wood when respiking.

A Novel Joint for Trestle Posts.

We show in the accompanying cut details of the intermediate joint of the posts and batter-posts of double-deck trestles as designed for the Harriman Coal & Iron R. R., by J. P. SUVERKROP, the Chief Engineer. It will be seen that this joint differs somewhat from the general practice. The posts and batter-posts are continuous throughout, without mortice, tenon or dap. The mud sills and floor sills are 12 × 12-in. timbers, dapped over the ends of the posts 1 in., and instead of an intermediate sill being used the two timbers forming the post are simply butted together and held by two 12 × 5-in. timbers dapped over the post 2 ins., and secured to it by ¾-in. drift bolts as shown in the cut. To prevent displacement parallel to the bridge the trestle bents are connected by diagonal bracing and also by a longitudinal timber at each intermediate joint, dapped over the transverse timbers 2 ins., and secured to them by ¾-in. drift bolts. All junctions of wood against wood and all iron work receive two coats of bridge paint before erection.

Experiments on the Use of Steam Jets for Producing Forced Draft in Boiler Furnaces.

In our issue of April 4, 1891, we described some of the principal devices used in locomotive practice for diminishing smoke by blowing air into the fire box with a steam jet. The last report of the Bureau of Steam Engineering, U. S. Navy, describes some careful experiments on the use of steam jets for forcing the draft of steam launch boilers, which are especially interesting as showing what a waster of fuel a steam jet blower often is. Five different forms of jets were tested, and the steam consumed by them was found to be from 8.3% to 21.2% of the steam produced by the boiler under which the steam jet was used. Of course these figures would not apply to locomotive practice, where the forced draft is produced by the exhaust, and the steam jet is chiefly used to cause intimate mixture of the air and combustible gases; but the very large consumption of steam by even a single jet of small diameter



Experimental Steam Jet Nozzles.

is a matter which users of steam jet blowers under either locomotive or stationary boilers cannot afford to ignore.

Of course there are cases where the use of a steam jet blower may be good practice. There are others, however, in which a blower rather than a steam jet is by all odds the thing to use if a forced draft is desired.

In the tests carried out in the New York Navy Yard two boilers were used. One was a square boiler with inclined tubes (total grate surface, 3.2 sq. ft.) the other, which supplied steam to the jet under the first boiler, was a navy-launch boiler, "type 6 × 6." The steam pressure in each boiler was kept at 80 lbs. The temperature of the feed-water varied only about 1° from 80° in each test. The coal consumption under the small boiler was not measured, it being only desired to determine the amount of steam used by the different jets.

Each style of jet was subjected to a 4-hour test, observations being taken every fifteen minutes. The following table summarizes the result of the test. Cross sections of the several jets tested are shown in the accompanying cut.

	Jet Number.				
	1	2	3	4	5
Lbs. of coal burned in 4 hours	311	450	182	344.5	354
Lbs. of refuse	76.5	104.8	45.5	82.7	84.4
Lbs. of combustible	234.5	345.2	136.5	261.8	269.6
Percentage of ash	24.6	23.3	25	24	23.8
Lbs. coal burned per sq. ft. grate per hour	24.3	35.2	14.2	26.9	27 7
Lbs. water evaporated per hour, boiler using jet, lbs.	463.8	580	361	528 5	545
Boiler supplying jet, lbs	97 5	120	30	63.2	76.25
Percentage of steam made by large boiler, used by jet	21.2	20.7	8.3	12	14

It appears from the above that the plain jets are the most economical of steam, although Jet No. 2 forced the boiler at a higher rate than any other. Of course for use on a launch the steam jet is the only practicable form of blower; but where a stationary boiler is to be worked regularly under forced draft it is evident enough that a steam jet will make large demands on the coal pile. Even a 1-16 in. jet will use a pound of steam every 2 minutes. The experiments are open to a little criticism on account of the small size of pipe used to convey steam from the boiler to the jet. This was ¼ in gas pipe, having an actual internal diameter probably of about 0.36 in. In the case of Jet No. 2, which used 120 lbs. steam per hour or 2 lbs. per minute, the velocity of steam in the pipe must have been over 2,000 ft. per minute. The loss of pressure due to friction in this small pipe doubtless very materially decreased the effectiveness of the jets, especially of Nos. 1, 2 and 5, which used large amounts of steam.

The Beetaloo Dam, South Australia.

We are indebted to Mr. ALEXANDER B. MONCRIEFF, M. I. C. E., Engineer-in-chief, Adelaide, South Australia, for the accompanying view of the Beetaloo dam, in construction, and for the following data concerning this interesting engineering work.

In our issue of May 30, 1891, a plan, section and view of the finished dam were given, together with a general description which we will not repeat here. The dam and concrete portion of the bye-wash, shown in the cut, is a monolith containing 60,159 cu. yds. of cement concrete. The total cost of this portion of the work was £127,000, or $10.16 per cu. yd. The work was commenced on Feb. 28, 1888, and was finished Oct. 18, 1890. Work was twice stopped by floods, but for a few days at a time only.

The concrete for 46 ft. above the foundation was made of one part Portland cement, two parts washed sand and four parts of broken stone made to pass through a 2-in. ring. Above 46 ft. one cask of cement was used to the cubic yard of concrete. The water used was not measured owing to the changeable climatic conditions.

Beetaloo is situated among the hills 7 miles from the nearest railway station, and the detail of the cost of the work is given by Mr. MONCRIEFF as follows:

	Per cu. yd.
Stone, quarried and broken by hand, washed and delivered at work	$1.46
Stone, quarried and broken in a crusher, screened, washed and delivered at the work	.84
Pit sand, delivered, screened but not washed	1 48
Sand, washed and moved to the work, with a loss of 2½ in handling	2.04
Cement delivered on the work, average per cask	$3.72

The above prices include all charges, depreciation of machinery, tools and supervision. The pay of laboring men was $1.68 for a day of 8 hours. It must be remembered that literally everything, except stone, sand and water, had to be imported. The cement came from Germany and the other materials from England.

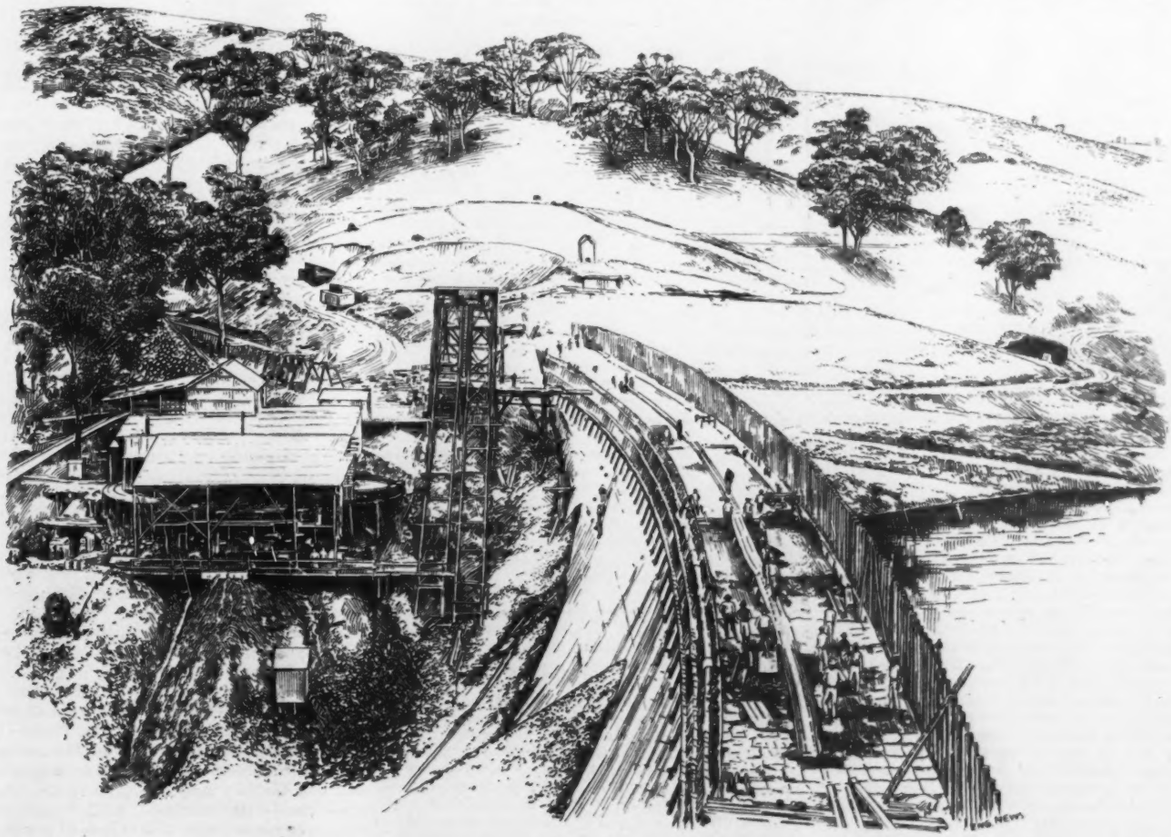
The method of making the concrete was as follows: Sheds for the machinery were erected on the hill side—in one of these the cement was weathered. The broken stone was passed through revolving drums in which the washing was done, and delivered into side-tip trucks each holding enough to make half a yard of concrete. This stone was deposited in an even layer on one of two trays, used alternately. Over the stone was spread the necessary quantity of sand also gaged in a side-tip truck, while the cement was similarly delivered from a third truck. The tray was then lowered at one end and jolted while the contents fell into a semicircular concrete mixer in which worked an interrupted Archimedean screw where the water was added. When thoroughly mixed the concrete fell into trucks which held ½ yd. each: these passed on to a hoist by which they were raised or lowered to the level required, and having been run off onto the dam the contents were tipped in place, and rammed by hand.

The greatest care was taken to have the surface of the set concrete picked, washed and brushed before a fresh layer was deposited, and the new concrete was kept covered from the sun while setting. The framing was held in place by bolts bedded in the concrete, the nuts being inside. When the frames were removed these bolts were screwed out, or when rusted were broken off. No rendering or plastering was allowed, and the marks of the boards are plainly visible now.

A record of cement tests forwarded by Mr. MONCRIEFF indicates the cements by the names of the ships bringing them. But the 7-day test of neat cement ranges from 394 lbs. to 573 lbs. With 2 sand and 1 cement, for 7 days, the tests ran from 212 to 256 lbs. The 28-days' test, neat cement, ran from 466 to 630 lbs.; and with 2 sand and 1 cement, for the same period, 266 to 310 lbs. The 2 years' test showed for neat cement 609 to 652 lbs., and for 2 sand to 1 cement, 388 to 445 lbs.

Standard Gages for M. C. B. Standard Car-Couplers.

The Executive Committee of the Master Car Builders' Association announces the adoption of the standard gages illustrated herewith for testing new couplers of the M. C. B. type to determine whether they conform with sufficient accuracy to the standard contour lines adopted by the association. By referring to the report of the Cape May convention on page 564 of our issue of June 13, the variations from the standard contour of the various makes of M. C. B. coupler may be seen. A template was at that time recommended by the Executive Committee, but as several members expressed a desire that the committee should go further and arrange for furnishing gages to members of the association with some guarantee of accuracy, the whole subject has been reconsidered by the committee; and as a re-



THE BEETALOO DAM, SOUTH AUSTRALIA. Alexander B. Moncrieff, Chief Engineer.

sult the gages shown in Figs. 1 and 2 have been recommended for use by makers and purchasers of M. C. B. couplers. We quote from the official circular as follows:

The gage for new couplers shown in Fig. 1 is announced in lieu of the gage proposed in the committee's report at the Cape May convention, because it provides means for gaging the contour lines, excepting the thickness of the knuckle, at points throughout the whole essential extent of the standard form of contour, and it controls the variation in both directions from the standard, whereas the gage proposed in the report was only a minimum gage, for a portion of the standard contour and its use would involve numerous measurements at different heights for the maximum variation, instead of gaging for both limits.

The gage for new knuckles shown in Fig 2 is announced as a proper gage for knuckles, allowing $\frac{1}{16}$ in. variation each way from the standard dimension of 3 ins., instead of $\frac{1}{16}$ in. one way only, as recommended in the report last June. It is thought desirable to allow more than $\frac{1}{16}$ in. variations, partly on account of the necessary taper in cast knuckles.

The committee practically withdraws its recommendation of last June of a standard gage to determine rectilinear limits of M. C. B. couplers, but recommends limits substantially the same as these then proposed, the measurements to be made by any means convenient. Arrangements for the manufacture of the gages have been made with the Pratt & Whitney Co., Hartford, Conn. They will be made of best gray iron, with the bearing points of hardened tool steel. The price per set will be $35, provided at least 50 sets are ordered in advance, and those who wish can make their orders conditional on this number of orders being sent.

It is to be hoped that this action of the Executive Committee will meet a proper response from both manufacturers and purchasers of M. C. B. couplers. There is a tendency in the introduction of new styles of the M. C. B. coupler to introduce variations for variations' sake. Even in so essential a point as the standard contours, manufacturers have not hesitated to offer innovations in utter disregard of the fact that uniformity is, above all things, the essential feature in this matter. Since every coupler must couple with every other coupler, the action of the manufacturer who refuses to follow the scandard contour fixed by the association is similar to that of a man who should begin to manufacture nuts with some peculiar sort of screw thread and send them out to be used with ordinary bolts.

Now that standard gages for determining the contour lines have been adopted and made accessible there is no longer an excuse for wilfully varying from the standard.

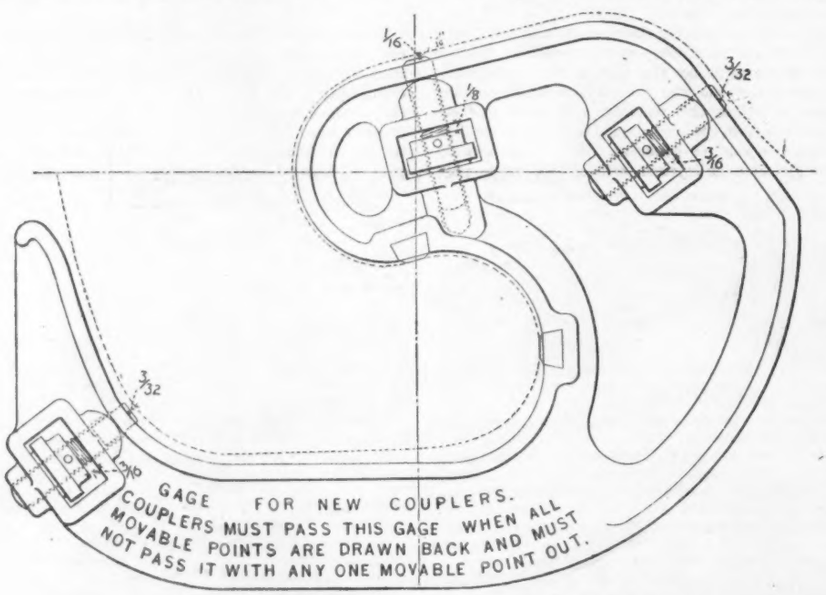


FIG. 1. STANDARD GAGE FOR NEW M. C. B. CAR COUPLERS.

(Broken Line is Standard Contour.)

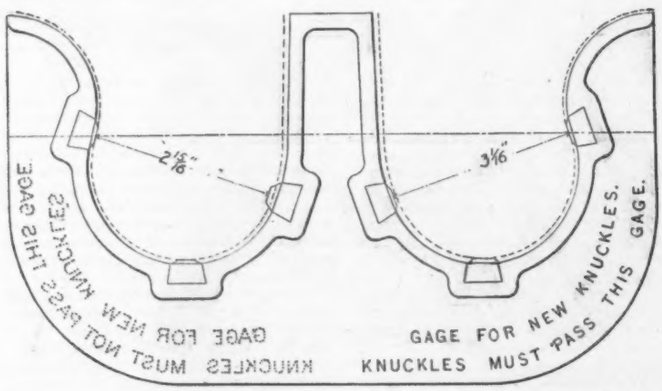
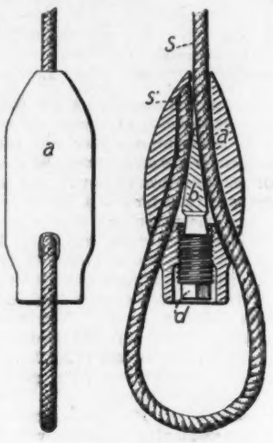


FIG. 2. STANDARD GAGE FOR NEW M. C. B. COUPLER KNUCKLES.

(Broken Line is Standard Contour.)

A Wire Rope Holder.

The purpose of the device here illustrated is to form a strong loop in the end of a wire rope without splicing, and very quickly. The holder consists of a cast iron block *a*, with four holes in it. The rope is passed through these holes, as shown in the cut, and a cast iron wedge, *b*, hollowed on the sides to fit the rope, is put in place and driven home by turning the screw plug *d*. This wedge thus forced into place grips the rope so tightly that it is impossible to draw it out of the block. In cases where it is not desirable to pass the free end of the rope clear through



A Wire Rope Holder.

the block *a*, the casting is made as here shown. In service, a lining of galvanized iron is usually placed inside the loop, so as to take the wear and preserve the rope. We are indebted to *Engineering* for the cut here shown, and the device is being introduced into England by Messrs. Thompson & Co., of London.

Carrying a Cable Railway Across a Draw-Bridge.

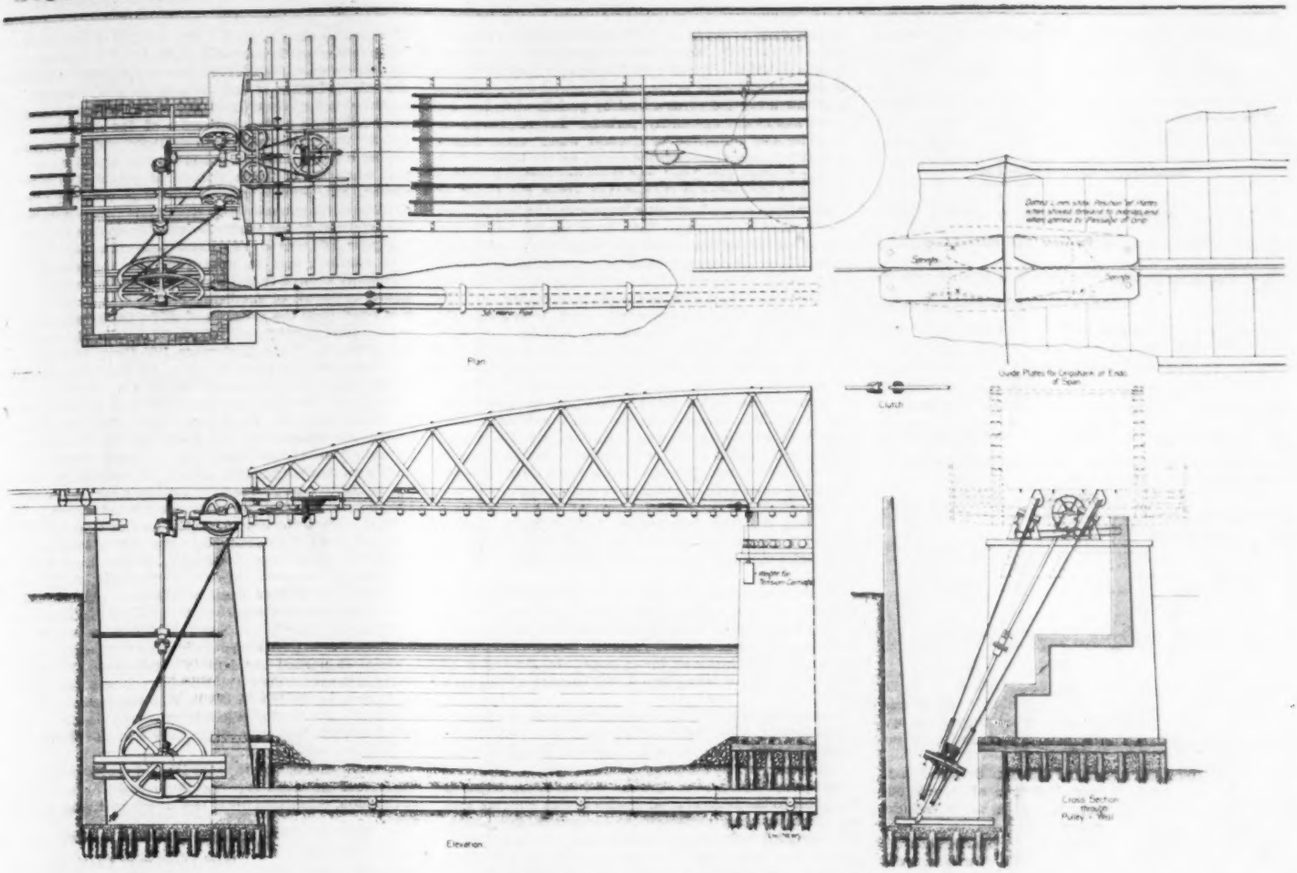
While it is contrary to our usual custom to illustrate mechanical devices before they have been proved by actual service, we have made an exception in the case of the apparatus shown in the accompanying engravings, as we believe many of our readers will be interested in the ingenuity of the device, and the simple solution which it presents to what has thus far been an unsolved problem in engineering.

To carry a cable railway across a drawbridge has hitherto been counted impossible; and in the city of Chicago, where cable railways and drawbridges are numerous, the cable railways have had to tunnel beneath the Chicago river to secure a passage. A tunnel for the West Chicago Street Ry. Co., near Van Buren St., was illustrated in our issue of Feb. 22, 1890. The disadvantages of a tunnel are its cost (the Van Buren St. tunnel cost $750,000), and the liability to accident on the steep inclines leading to and from the tunnel. It has, of course, the advantage over a drawbridge that there are no delays to traffic when the draw is opened.

The device which we illustrate is the invention of Mr. F. W. L. CHURCH, and the details were worked out by Mr. W. E. WILLIAMS, C. E. Its working is clearly shown by the drawings. The main cables pass over sheaves at the bridge portal and thence downward over long pulleys at the bottom of a well reaching a little below the river bottom. They are carried across the river in a 36-in. iron pipe. Upon the same shaft as the pulleys at the bottom of the well are bevel gears, which drive an oblique shaft with a gear at its top driving a horizontal shaft in the center of the roadway between the two tracks.

Another shaft on the end of the draw-span has its end opposite the first shaft when the bridge is closed; and a friction clutch, worked by the bridge tender, connects the two. A system of gearing from this shaft drives a short cable running the length of the draw-span. The clutch can be interlocked with the mechanism for locking the span in position if desired. The auxiliary cable on the bridge has a tension carriage so that it can be kept up to its work at all times.

The variation in adjustment and position of the draw-span makes essential some device for guiding the grip shank from the slot rails on the land to the slot rails on the bridge. The device used is a double



PROPOSED METHOD OF CARRYING A CABLE RAILWAY ACROSS A DRAWBRIDGE.

pair of guide plates with curved edges, the pair on the bridge being thrust forward to overlap those on the land by the same mechanism which locks the span in position and engages the friction clutch.

A Remarkable Feat of Mental Calculation.

As a general rule, mathematical prodigies, or persons endowed with abnormal powers in the mental solution of numerical problems, have not been gifted with more than ordinary abilities in other directions. An exception to this rule was the late G. P. BIDDER, at one time President of the Institution of Civil Engineers, whose powers of mental calculation were something marvelous. In a paper read before the Institution in 1855 he described some of his methods of working, and alluded to still higher feats as possible, among which was the determination of logarithms. Of this he said:

> Were my powers of registration at all equal to the powers of reasoning and execution, I should have no difficulty in an inconceivably short space of time in composing a voluminous table of logarithms.

Subsequently Mr. BIDDER, who seemed to consider this a sort of challenge to himself, performed this remarkable feat; and the fact, with his methods of working, have been briefly stated in a recent paper read before the Institution by the Honorary Secretary, Mr. W. POLE, which we reprint as follows:

> The enormous difficulty of mentally computing the logarithm of a given number to seven or eight places of decimals will be evident if any one will consider how he would set to work to calculate, mentally and accurately, the value of x in the equation say:
>
> $$10^x = 369353,$$
>
> or how he would mentally sum up a large number of terms of the series:
>
> $$0.86858896 \left\{ \frac{n-1}{n+1} + \frac{1}{3}\left(\frac{n-1}{n+1}\right)^3 + \frac{1}{5}\left(\frac{n-1}{n+1}\right)^5 + \text{etc.} \right\},$$
>
> n being a large number whose logarithm is to be found.
>
> Mr. BIDDER had often been in communication with the author of this paper on the subject of mental calculation, and toward the end of his life he communicated this discovery, and requested the author to aid him in testing its accuracy. For this purpose the following series of prime numbers was selected by the author, with the aid of a mathematical friend:
>
> 71, 97, 659, 877, 1,297, 6,719, 8,963, 9,973, 115,249, 175,349, 290,011, 350,147, 229,847, 369,353.
>
> Each of these was given, separately, to Mr. BIDDER, and the logarithm in answer was returned very quickly. The time occupied on each varied from half a minute to four minutes, being generally about two minutes.
>
> The logarithms were given in eight places, but the Author had only Hutton's table of seven places to check them with. The majority were stated at first quite correctly; but in some cases errors occurred (generally of one figure only), which were discovered and corrected on simply announcing that the answer was not exact. The experiment was at any rate amply conclusive as to the real efficiency of the mental power to perform the calculations for any numbers.
>
> After the tests were over Mr. BIDDER was good enough to explain fully the manner in which the calculations were made; and as this is quite a unique incident in mathematical history, it may be worth putting on record. Indeed, Mr. BIDDER wished it to be published as an addendum to his lecture, and gave it to the Author with that view.
>
> In general terms, it may be stated that his mode of calculation was not based on any of the formulae proper for calculating logarithms in the first instance; for probably no amount of genius and skill would suffice for reducing them to manageable form for mental calculation, when the given number was large. Neither was it a matter of simple memory, for it would be equally impossible for any one to recollect the logarithms, to eight places, of hundreds of thousands of numbers.
>
> It was, however, founded on a power of memory, of a more limited range. Mr. BIDDER'S process may be said briefly to be this: having stored in his memory the logarithms of a few simple numbers, he was able, by his wonderful skill in dealing with figures, to make use of them, mentally, to calculate accurately the logarithms of any other numbers however large. A brief description will give an idea of the manner in which this was done.
>
> In the first place, as to the mnemonic bases used. He knew by heart the logarithms of a great many *small prime numbers*, nearly all, he said, under 100, and some few above.
>
> Secondly, it will be easily understood that these would enable him to calculate the logarithms of any large numbers which were multiples of those he knew. Thus for the logarithm of 63 he had only to add together the logarithms of 7 and 9; for the logarithm of 3567, he had only to sum up the logarithms of 29, 41, and 3, and so on.
>
> In carrying out this process he had an almost miraculous power of seeing, as it were intuitively, what factors would divide any large given number not a prime. Thus if he was given the number 17,861, he would instantly remark it was $= 337 \times 53$; or he would see as quickly that 1,659 was $= 79 \times 7 \times 3$. He could not, he said, explain how he did this, it seemed like a natural instinct to him.
>
> These two qualifications, therefore—the knowledge of the logarithms of certain small primes, and the power of reducing large compound numbers to their component factors—constituted the foundation on which Mr. BIDDER'S operations proceeded. They would suffice for determining the logarithms of a great many numbers by simply adding together the logarithms of their component factors, which he could do mentally with the greatest ease.
>
> But it still remains to be explained how he treated the case of large primes, and this is really the great interest of his process.
>
> His first endeavor was to find some multiple number *very near* the number given, differing from it only in the last place of figures, and if possible only by unity. For example, being given the number 1,051, he would easily find the logarithm of 1,050 ($= 30 \times 7 \times 5$) to which he would then have to make an addition for the difference of 1. This addition would be very important (for the accuracy aimed at), as it would affect the last five figures of the logarithm. The operation is difficult and complicated, and the manner of dealing with it was really the key to Mr. BIDDER'S success. It is due to him, therefore, to explain it somewhat fully.
>
> His method consisted in the use, as a basis, of the following table, which he knew by heart (only seven places are given here, he himself used eight):

For an Addition to any Number n of	There must be added to its Logarithm.
$\frac{n}{100}$ ..... Log. 1.01	= 0.0043214
$\frac{n}{1000}$ ..... Log. 1.001	= 0.00043407
$\frac{n}{10000}$ ..... Log. 1.0001	= 0.0000434
$\frac{n}{100000}$ ..... Log. 1.00001	= 0.0000043

> Suppose, therefore, as in the above case, there is to be added to the logarithm a sum corresponding to an addi-

tion to the number of $\frac{n}{1050}$ (= 1). Mr. BIDDER would take the proportion $\frac{1}{1000} : 0.0004341 :: \frac{1}{1050} : 0.0004134$. This calculation would pass through his mind instantaneously, and thus he would get, by mental addition—

Log. 30	= 1.4771213
" 5	= 0.6989700
" 7	= 0.8450980
Addition for the 1	= 0.0004134
Log. of 1051	= 3.0216027

But it would sometimes be necessary to add a larger proportion than above mentioned, say between $\frac{n}{100}$ and $\frac{n}{1000}$. For these he adopted mentally a kind of proportionate sliding scale. Thus, for the number 601, he would see that $\frac{n}{600}$ would require 0.0007232, so that—

Log. 600	= 2.7781513
Addition for the 1	= 0.0007232
Log. of 601	= 2.7788745

He preferred that the differences should be less than $\frac{n}{1,000}$, and to attain this result he would often multiply the given number by some other. For example, with the number 877, instead of taking it as—

$$(73 \times 12) + 1$$

he multiplied it by 13, which gave 11,401 $= (609 \times 19) + 1$ and he found the logarithm thus—

Log. 600	= 2.7781512
" 19	= 1.2787536
Addition for $\frac{1}{0.00043428 \times 1.14}$	= 0.0000381
Log. 11401	= 4.0569429
Deduct log. 13	= 1.1139433
Log. 877	= 2.9429996

Similarly to find the logarithm of 97 (which he could not remember at once), he multiplied it by 33, giving 3201 $(= 100 \times 2^5 + 1)$, which he worked in the same way, saying that it was more certain than 96 + 1, and quite as easy to him.

It is worth mentioning that Mr. BIDDER declared that the logarithms he knew by heart had been all calculated mentally, he had never written them down nor looked for information into a table for many years.

Although this great feat is probably far in advance of any other mental calculation on record, it will be seen that, when thus analyzed, it is explained on the same principles as are given in Mr. BIDDER'S lecture of 1855, and which may be classified as follows:

1. A good memory for retaining certain standard numbers for reference.

2. The power of performing the ordinary simple arithmetical operations of multiplication, division, proportion, etc., on large numbers with great facility, quickness, and accuracy.

3. A remarkable intuitive detection of multiple numbers, and an instantaneous perception of the factors forming them.

4. The power of what Mr. BIDDER called "registration," *i. e.*, of keeping a string of successive processes and results clear in the mind, and working accurately upon them.

5. The power of devising instantly the best mode of performing a complicated problem, as regards facility, quickness and certainty.

All these were undoubtedly the result of natural gifts; the second, third and fourth special and phenomenal. The fifth Mr. BIDDER considered to be largely improved by practice and experience.

It is obvious that such powers cannot be taught to even the most promising and intelligent pupils; but undoubtedly the processes described may furnish useful hints for improving the power of practical calculation.

Influence of Ground Water Upon Health.*

The examination of the historic records or of the published Mortality Tables of this and other countries shows that there are certain conditions which are found to be present when certain diseases are most rife. It is also found that, after eliminating certain meteorological and other influences which are supposed to affect disease, some particular diseases appear to be solely influenced by the hygrometric condition of the ground and the volume of water which is present in the ground.

In historic periods when particular epidemics have been rife, they have mostly occurred in times of drought, in which it has been established beyond doubt, by the evidence of the failure of springs and rivers, that the ground water was then exceptionally low.

The actual measurements of the ground water in this country, in some cases, go back for a period beyond that of the registration of death, consequently a comparison can be made between the state of the ground water and the death rate of any particular period, and when such examination is made it is found that there is a coincidence between the state of the ground water and the deaths recorded. The deaths follow, as a rule, in the inverse ratio, the state of the lowest ground water; that is, high low water indicates a healthy period, while low low water marks the unhealthy periods. Investigations respecting the influence of ground water upon health should be studied over limited areas, as the distribution of rain is often very local, and there are variations in the geological character of the soil that affect the result of observations carried on over large areas; and on this account, while observations have been carried on by the author over an extended area, he has always used local observations to compare with the mortality returns in the same districts and he has specially dealt with the records of Croydon, which is the place where the observations as to percolation, evaporation and the hygrometric condition of the soil have been locally studied.

There is every reason to believe that the ground water itself, except when polluted, exercises no influence as a cause of disease, but it is merely the measure or indicator of the influences which are at work within a polluted soil, and of certain organic changes which evidently take place within the dark recesses of the soil, and which lead to the development of the conditions favorable to a certain class of disease. That the earth does exercise a baneful effect upon health is well known from the experience in this country of the unhealthiness of cellar dwellings, and from the fact that persons habitually living upon ground floors are not so healthy as those living in the upper stories of buildings removed from the influence of the ground.

There is a seasonable fluctuation in the waters in the ground, and, as a rule, these waters are lowest in the autumn and early winter, and highest in the spring or early summer, but in some years the period of both low and high water varies as, for example, the low water of last season did not take place until February of this year (1891).

It is also known that the artificial lowering of the subsoil waters of a district has produced the same effects upon the health as occur when a general lowering of the ground water arises naturally from drought.

The actual drying of the ground is a condition which is favorable to the general good health in this country, and this circumstance often masks, in the general death rate, the potential influence of certain diseases, so that the general health of a district appears to be good while at the time it may suffer intensely from a certain class of disease of which low ground water is the indicator. When, however, the conditions become extremely intense, and the ground water exceptionally low, the influences at work affect the death rates as a whole. On the other hand, in periods of excessive rain with high ground water, the conditions are usually favorable to health, and all places in which the ground waters are of a uniform level, such as seaside places, which are governed by the mean tide level, and river valleys with porous soils, like that of the River Wandle, in which the water is headed up to a uniform level by mills, are usually healthy.

It is known that the measure of the effect of the ground water is most marked in districts which draw their water supply from the ground, and among that section of the inhabitants who use such water for dietetic and other purposes, especially in the case of young children and teetotalers.

The unhealthy time after the period of excessive low water is that when the first rain begins to percolate through the soil, just as if it washed out matters which had been specially prepared or were retained in the dark recesses of the soil, into the water, or by driving out the ground air specially charged with the poison of disease. It is by no means uncommon both in this and other countries to find that particular epidemic outbreaks which have become rife at a low-water period can be traced to particular rainfalls. In this country, since we have the registration of deaths, those quarters of the year when percolation has first commenced after periods of exceptionally low water are, without exception, the most unhealthy seasons that have been recorded. The quarters of the year when percolation first commenced after exceptionally low water have been most unhealthy, as for example, the March quarters of 1838, 1845, 1847, 1853, 1855, 1864, 1865, 1866, 1875, 1890, 1891, which, with the exception of the third quarter of 1849 (the cholera year), are the most fatal seasons on record.

There is no doubt that the sanitary condition of the district greatly influences the results of the movements of the ground water, and the greater the amount of disturbance or the number of disturbances of the ground water in the course of the season in insanitary districts, the greater and more marked the influence upon health until the period arrives when the soil has been washed free from its impurities and the waters have accumulated in the ground.

Certain diseases have their allotted seasons and conditions favorable for their development and spread, and there are a number of diseases usually most rife when the ground waters are low, such as enteric fever, cholera, small pox, diphtheria and others.

The state of low ground water as being a condition accompanying epidemics of typhoid fever is a matter of constant observation, and it is a well authenticated fact that all epidemics of this disease in this country have occurred in periods only of low water, or when immediately following a very low state of the ground water. Ground water influences both small-pox and diphtheria in a most marked manner, but in directly opposite ways, so that when one of these diseases is present the other is absent. Small-pox is accompanied or preceded by intense dryness of the ground, while diphtheria occurs only when the condition of the ground is one of continued dampness. The year 1871 was a very fatal year from small-pox in this country, and in that year the percolation experiments showed that the ground was intensely dry. In 1876 an outbreak of small-pox occurred at Croydon, and continued until the autumn of 1877. Outbreaks of this disease have subsequently occurred in this place in 1881-82 and 1884-85. Since September, 1885, there have been no deaths recorded from small pox in Croydon, but diphtheria has been very prevalent during the whole of that period, and the ground has been in a constant state of dampness, so much so, that, with the exception of one month, October, 1886, a measurable quantity of water flowed from the percolation gages every month during all this long period. The last outbreak of small-pox in 1884-85 was preceded by 7 months, and that of 1881-82 by 5 months, when no water percolated through the ground. Since the time when the author first observed this marked coincidence between the dryness of the ground and outbreaks of small-pox, he has learned from the report of Surgeon-Major G. HUTCHESON, M. D., Sanitary Commissioner of the Northwestern Provinces and Oudh, that the counterpart of this has been observed in India in reference to small-pox, which, it is stated, "is controlled or kept in abeyance by damp and moisture."

The most marked incident in connection with ground water is the remarkable parallelism between the deaths of children under 5 years of age and the lowness of the ground water; in fact, it is found that the deaths in this case fluctuate inversely in proportion to the volume of the water in the ground.

The following figures give the level of the lowest ground water, and the death rate of children under 5 years of age at Croydon, calculated upon the numbers living at that age.

Year.	Depth of Water in Wickham Court Well.	Death rate of Children under 5 Years
1872	9.00	54.71
1873	20.00	47.15
1874	7.75	51.52
1875	6.08	57.27
1876	7.00	50.98
1877	25.75	47.18
1878	21.83	51.36
1879	31.00	44.57
1880	19.50	50.11
1881	22.08	45.17
1882	18.42	54.84
1883	17.74	41.57
1884	7.33	50.76
1885	5.17	48.90
1886	10.75	40.72
1887	6.44	42.90
1888	9.92	35.72
1889	8.58	38.78
1890	4.00	52.56

In 1882 the excess of deaths was no doubt due to the direct pollution of the water supply of the district. And it should be observed that since 1884 the low waters in this well are lower than would be the case naturally, as since this period the waters have been abnormally lowered by the establishment of the New Croydon Water Work Co.'s station at Addington. If the deaths from diarrhœa are eliminated as being affected more by temperature than by conditions affecting the state of the ground water, the parallelism between the volume of water in the ground and the death-rate becomes even more marked.

This coincidence between the rates of mortality of children and ground water occurring period after period is tantamount to positive proof that ground water, at least, if not the direct cause, is the measure of the influence at work which seriously menaces the lives of young persons. Those who require further information upon this subject will find it in the author's recent Presidential Address to the Royal Meteorological Society.

The Education of Locomotive Engineers and Firemen.

Now that so much scientific attention is being paid to the improvement of the locomotive to increase its efficiency and economy, for the benefit of the railway companies, it is becoming more and more necessary for the companies to have these engines handled by men who intelligently understand their work, keep up with the progress being made in mechanical matters, and are at the same time careful and reliable men. Such a grade of employees is also becoming more necessary in the prompt, safe and reliable handling of the increasingly fast and heavy passenger and freight traffic on our trunk lines.

* By Baldwin Latham, Mem. Inst. C. E., Mem. Inst. M. E., F. G. S., F. S. I., F. S. S., P. R. Met. Soc. Read at the Congress of Hygiene and Demography.

ELEMENTS OF WEATHER IN THE UNITED STATES, OF MOST INTEREST TO ENGINEERS, FOR THE MONTH OF AUGUST, 1891.

[Furnished to ENGINEERING NEWS by the Department of Agriculture.]

	STATION.	Temperature. (Deg. Fah.) Average.	Max.	Min.	Range.	Wind. Velocity in miles per hour. Average.	Maxim.	Direction at time of max. velocity.	Precipitation — rain and melted snow. Inches. Total.	Heaviest in 24 hours.	Number of rainy days.
NORTHERN CITIES.	Northfield, Vt.	64.5	75	54	47	6.3	30	SW	4.78	1.75	14
	Portland, Me.	66.0	73	59	38	6.7	24	S	1.15	0.54	11
	New York City	73.6	80	67	37	8.3	27	S	5.87	3.20	17
	Pittsburg, Pa.	71.7	81	62	46	4.4	18	S	1.60	0.54	13
	Chicago, Ill.	69.0	76	62	47	12.4	48	NE	4.52	1.92	10
	Omaha, Neb.	72.2	81	64	53	6.6	26	SW	2.02	0.89	8
	St. Paul, Minn.	67.5	78	57	55	6.3	30	NW	3.42	1.80	9
	Duluth, Minn.	62.3	69	56	41	5.7	25	NW	3.11	1.08	10
	Bismarck, N. Dak.	66.0	79	53	59	8.4	38	NW	1.43	0.97	9
	Average	68.1	77	59	47	7.2	30	.....	3.10	1.41	11
SOUTHERN CITIES.	Washington City	74.5	83	66	41	4.6	34	NW	4.18	1.59	16
	Louisville, Ky.	74.0	83	65	43	5.0	20	NW	5.42	2.82	15
	St. Louis, Mo.	74.8	83	66	43	8.8	38	W	2.75	0.89	12
	Savannah, Ga.	80.3	88	72	30	5.8	38	NW	11.54	3.30	18
	Leavenworth, Kan.*	....	..	..	..	....	..	.....	....	....	..
	Jacksonville, Fla.	82.3	91	74	27	6.6	41	SW	3.67	1.38	14
	Chattanooga, Tenn.	76.6	87	66	41	3.8	16	NW	3.17	1.48	10
	New Orleans, La.	81.2	88	74	20	6.5	28	N	1.69	0.40	11
	Memphis, Tenn.	76.7	86	68	41	5.3	35	NW	3.18	1.02	7
	Palestine, Tex.*	....	..	..	..	....	..	.....	....	....	..
	Average	77.6	86	69	37	5.8	32	.....	4.45	1.61	13
WESTERN CITIES.	Helena, Mont.*	....	..	..	..	....	..	.....	....	....	..
	Port Angeles, Wash.*	....	..	..	..	....	..	.....	....	....	..
	San Francisco, Cal.	61.8	69	54	42	10.6	34	SW	0.02	0.02	1
	Salt Lake City, Utah	74.4	87	61	45	5.4	32	W	0.46	0.16	6
	Denver, Col.	69.2	83	56	48	6.2	30	N	2.84	1.05	11
	Yuma, Ariz.	91.5	105	78	41	6.4	30	S	0.06	0.05	3
	Santa Fé, N. Mex.	68.3	80	56	42	7.0	32	NE	1.02	0.44	10
	Average	73.0	85	61	44	7.1	32	.....	0.88	0.34	6

* No record.

The questions of the education of engineers and firemen, and of the selection of the most suitable men, are consequently of importance, and railway companies, or their executive officers, have them under careful consideration. At the convention of the American Railway Master Mechanics' Association, at Cape May, N. J., in June, 1891, a report was made by a committee on examinations for engine drivers and firemen, an abstract of which was given in our issue of June 20. This report recommended that it is better for railways to educate and promote their men, than to hire them from other roads. The committee reported favorably on the plan of progressive examinations suggested by Mr. JOHN A. HILL, associate member. On another page will be found a notice of a book issued by Mr. HILL, explaining his system, and giving a series of examination questions and answers. From the opening remarks of this book we make the following abstract:

Locomotive engine running is a responsibility than which there is none greater, and the most painstaking care is none too efficient in selecting and training men for this more than responsible position. The way to secure a good class of engineers is: *First*—Select good, clean material, inspect for culls, and have some quick and fairly accurate method of testing for such defects as would prevent the candidate from ultimately becoming a first-class passenger engineer. *Second*—Provide the opportunity and means, or point out the way, to the student to learn the rudiments of his business first; teach him how to fire before he goes into valve motion. *Third*—Provide for an incentive to the learning of the right part first, and establish a point at which no progress or any other defect in the candidate for advancement will call for a termination of the apprenticeship. By the method here proposed responsible officers can provide a system of periodical examination of firemen, advance them step by step until they become thoroughly proficient enginemen; and abandon the usual rule of putting a conglomerate gang of men upon locomotives, letting them fire a term of years, and select the oldest for examination, only to find that he knows little about his business, is color blind, illiterate or intemperate, all of which should have been discovered before he was given a job at all.

The progressive plan provides in the preliminary examination for the establishment of a gage for candidates, one that proves that he is possessed of a common school education, is not afflicted with defective vision, is of proper age, etc., and points out to the candidate what he is expected to learn and how best to learn it. The first examination occurs after one year's actual service. The record of the candidate for advancement is looked up, and he is examined in the rudiments of his business, the questions being of an elementary order, to see that the subject is getting the proper groundwork of his trade. Especial attention is paid to his understanding of all signals in use by the road, as even the youngest fireman is responsible for the proper transmission of signals to his engineer; this point is especially important on single track roads. The second examination takes up the subject of fuel, combustion, boilers, and the duties of firemen. It insures his understanding something about the care of fires, draft appliances and economy of fuel, while he can put to practice some of the lessons learned. The third examination occurs after the third year of service, and is a thorough one on the mechanism of the engine, brakes, etc. The examiner requires a remedy or a cure for every conceivable breakdown liable to occur on the road, and this examination should be complete enough to warrant the superintendent of machinery in promoting the successful firemen as needed, upon their presenting him with a certificate of examination on train rules and time card from the proper officers of the transportation department. If the candidate fails to pass satisfactorily at this examination, he is to be apprised in detail where he is weak, and given a chance to post himself and try again when his turn for promotion comes, for with progressive examinations there can be no objection to "the oldest man" coming first.

The early examinations are mainly to secure the proper material, and then put the young fireman in the way of getting hold of the right kind of information, to advise him, guide him, and put him in the way of thinking and reasoning out things for himself. He is led to study certain important phases at a time when he most needs information on these subjects, and those who are inclined to put off and lag in interest are kept moving by the thought of the next examination. Some objectors will say, "They will learn these rules by heart and repeat them off like clock-work." Even so, this will do good rather than harm, and is far more than the majority of men learn before promotion now.

THE KAIPING RAILWAY IN CHINA, first opened for carrying coal, is growing into a very large concern, says the *London and China Herald*. The whole length of the completed line is now 200 li, or about 55 miles, but this is being extended with the full consent and assistance of the Chinese government.

THE £20 SUEZ CANAL SHARE is worth £110 in the London market. The British government owns 176,000 shares out of the total 400,000 shares, for which it paid $19,880,000. The dividend paid upon the original capital represented by the shares is about 23%. Until 1894 the British government takes only 5% upon the purchase money of the shares, but after that date it receives the whole dividend. The current story that Russia is seeking to control the Suez Canal by buying shares in the market with French money, means that she would have to purchase over 200,000 shares at a cost of about $110,000,000. As the reported French loan to Russia is only $80,000,000, this story hardly fits the facts.

A WATERFALL HIGHER THAN NIAGARA is reported as discovered by the Bowdoin College exploring expedition in Labrador. The falls proper are only 200 ft. high, but the short rapids above this increase the total altitude to 500 ft. It is the first scientific expedition made to these falls, and the full report is looked for with interest.

THE WATER SUPPLY OF EDINBURGH, Scotland, is to be increased and improved, according to *Industries*, London. The engineer of the Edinburgh Corporation, has reported in favor of the Manor Water scheme. The Manor Water is a tributary of the river Tweed, and the proposal includes the construction of two large reservoirs in the valley through which it flows, near to its junction with the Tweed, about 2 miles from Peebles. The estimated cost of the provision of land including damages of tunnel and cut-and-cover aqueduct for 24,000,000 galls. per day, and one line of pipes for 15,000,000 galls. per day, both to be employed for the supply of 10,000,000 galls. per day is $3,011,820. The additional estimate for providing pipes sufficient to convey 15,000,000 galls. per day is $1,200,380. Should the supply afforded by the Manor Water be exhausted by the city, a further quantity could be drawn from the Tweed. It is for this reason that the aqueduct is to have a capacity for 24,000,000 galls.

CONSTRUCTION NEWS.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

Dutchess County.—The contract for the masonry on this New York railway has been awarded to Geo. W. Beach, of Poughkeepsie, N. Y.

Concord & Montreal.—The citizens of Exeter, N. H., will present a petition to this company asking it to build a branch from East Epping to Exeter, N. H.

Cleveland, Wooster & Western.—Track laying commenced on this railway from Wooster to Lodi, O., 20 miles, Aug. 31, and it is expected to have the line in operation within a few days. It is stated that 15 miles will be in operation by Sept. 22.

Providence & Springfield.—The city of Providence, R. I., has voted $200,000 of bonds to aid in the construction of an extension to East Thompson, Conn., 8 miles.

Baltimore & Ohio.—About 200 men are now at work upon the Lick Hollow & Uniontown R. R., from Uniontown, Pa., to quarries, 3 miles. P. Sheehan, of Scottdale, Pa., is the contractor.

Boston & Maine.—This company is making surveys for a line connecting the Stony Brook, R. R. and the Worcester, Nashua & Rochester R. R., at Groton Station, Mass.

Portland & Rumford Falls.—This company will receive proposals for constructing the proposed extension from Canton to Rumford Falls, Me., until Sept. 21. Hugh J. Chisholm, President, 34 Exchange St., Portland, Me.

Pennsylvania.—This company will build a branch from Showell Station, on the Delaware, Maryland & Virginia R. R., to Ocean City, Md., a distance of 6 miles.

Adirondack & St. Lawrence.—Three companies have been chartered in New York to build the various sections of this railway. They are the St. Lawrence & Adirondack R. R. Co., the Malone & St. Lawrence R. R. Co., and the Newport & Poland Extension R. R. Co., and will build the line from Poland to Malone, N. Y.

Philadelphia & Reading.—The Williams Valley R. R. Co. has been organized to build the proposed branch of this road from Tower City to Brookside, Pa. The officers of the company are: President, H. T. Bressler; Secretary, C. M. Kauffman; and Treasurer, Wm. Elliott.

Hunter's Run & State Belt.—The contractor, L. L. Bush, has begun work on this proposed railway from Pine Grove Furnace, Pa., to slate quarries, 5½ miles. J. C. Fuller, Pine Grove, Pa., President.

Bristol.—H. G. Smith, of Rutland, Vt., Treasurer, writes us that about 200 hands are now at work upon this road from Fairhaven Station, to Bristol, Vt., 6¼ miles and that 3 miles of the grading are completed. Tracklaying will be commenced about Sept. 25. The right of way has all been secured and $20,000 of bonds obtained from the towns of Bristol and Lincoln. The Engineers are Chappel & Burke, Rutland, Vt.

Grayling, Twin Lake & Northeastern.—Rasmus Hanson, of Grayling, Mich., President, writes us as follows:

The surveys have been completed and grading is in progress for this railway from Grayling to Twin Lake, Mich., 27¼ miles. The work is very light and the grades and curves are easy. Wm. Crampton, of Bay City, Mich., has the contract and is to have the road completed by Jan. 1, 1892. A. Torrey is Chief Engineer.

Projects and Surveys.

Chelsea & Quarries.—A project is on foot to build a line of railway from Chelsea, Vt., to granite quarries.

Chicago, Union City & Cincinnati.—I. Frank White, of Union City, Ind., Chief Engineer, writes us that this railway is projected to run from Union City via Portland, to Bluffton, Ind., a distance of about 60 miles. Thirty miles are located and surveys are now in progress. The work will be light and the grades and curvature easy. J. C. Fawcett is President.

SOUTHERN.—Existing Roads.

Carolina Manufacturing, Mining & Improvement Co.—This company is building a railway from Sylvia to Webster, N. C., 4 miles. The line will probably be extended. H. M. Ramseur, Sylvia, N. C., Chief Engineer.

Norfolk & Western.—This company is considering the construction of a branch from its Clinch Valley Division to the plant of the Virginia Coal and Iron Co.—Surveys are in progress for a line from Coeburn, Va., up Big Tom's Creek.—The large steel bridge over the Ohio River at Kenova, W. Va., is nearly completed.

Baltimore & Ohio.—Work has been commenced on the line from Knowles, Md., to Fairfax Va.

Western Maryland.—The grading on the Potomac Valley R. R., from Williamsport, Md., to Cherry Run, W. Va., 14.3 miles, is nearly finished, and tracklaying will begin at once, and the line be opened for traffic in about 60 days.

Nashville & Knoxville.—Work is being rapidly pushed on the first 10-mile section of the extension east from Cookeville, Tenn. It is intended to have 5 miles graded within two months. The rails for laying 10 miles have been ordered and a portion have been delivered.

Richmond, Nicholasville, Irvine & Beattyville.—J. N. Pearson, of Richmond, Ky., Chief Engineer, writes us as follows:

Work has been discontinued on the extension of this railway owing to lack of funds, but it is hoped that arrangements will soon be made for securing sufficient money to complete the line to Beattyville, Ky. Since Jan. 1, the section from Richmond to Irvine, Ky., 22 miles, has been completed and is now in operation. This makes 61 miles of road completed and in operation. The section from Irvine to Beattyville, is 35 miles long, following the Kentucky River, and is comparatively light work. About 17 miles are now graded and 13 miles partly graded. On the section from Richmond to Irvine, Ky., there were about 8 miles of rough work, but the remainder was light. The work is in charge of the Chief Engineer.

Paducah, Alabama & Tennessee.—About 250 teams and 375 men are now at work on the extension from Paris to Hollow Rock' Tenn., 24 miles. The grading contracts have been let in sections of 3 and 5 miles. M. S. Carrter & Co., of St. Louis, Mo., have the contract for bridging and trestling and are now organizing their forces preparatory to beginning work.

Chesapeake & Ohio.—We have received the following information from this company:

The Craig Valley Branch running from Eagle Rock to New Castle, Va., 26.1 miles, has been opened for regular traffic.—The Warm Springs Valley Branch, which runs from Covington, Va., up Jackson River and Cedar Creek to Hot Springs, Va., 21½ miles, was opened for traffic Sept. 7. The route is along a narrow valley following the course of the river.

Projects and Surveys.

Halifax & Indian River.—This company, noted last week, has been chartered in Florida to build a railway from Daytona to Titusville, Fla., 50 miles. Among the incorporators are Geo. M. Robbins and Walter S. Graham, of Titusville, Fla.

McRae, Ocilla & Southwestern.—This company proposes to build a railway from Thomasville to McRae, Ga.

Brooksville & Lacoochee.—It is stated that arrangements have been completed for building this railway. L. G. Jenness, Brooksville, Fla., is interested.

Brunswick, La Grange & Northern.—This company proposes to construct a line of railway from Brunswick, Ga., via La Grange, Ga., to Anniston, Ala.

Western Carolina.—W. J. Kirk, of Anderson, S. C., General Manager and Chief Engineer, writes us as follows:

The charters of the Western Carolina R. R. Co. and the North Georgia Ry. Co., were obtained in the fall of 1890, and considerable work has been done in arranging matters preparatory to active work. It is proposed to build a line from deep water on Port Royal Sound west through South Carolina to the town of Clayton, Ga., 260 miles. From Clayton the line will branch, one line running through the Blue Ridge Mountains, down the Little Tennessee River via Franklin, N. C., to Knoxville, Tenn., 136 miles, and the other passing throught he four northern counties of Georgia, via Ducktown, Tenn., to Chattanooga, Tenn., 133 miles. Up to date only the preliminary surveys have been made on the most difficult mountain divisions. It is probable that all arrangements for beginning active work will be completed by next spring. The two companies have been organized, with the same officials for each company. The object of the road is to furnish a deep water outlet for the cotton of South Carolina and the hardwood timber of North Georgia and North Carolina, and the minerals of Tennessee and Kentucky. The road will be standard gage and first class in all respects. The officers are: President, E. B. Murray; Secretary, J. W. Bowden and Treasurer, J. A. Brock.

NORTHWEST.—Existing Roads.

Grand Trunk.—The following press dispatch from Winnipeg, Man., is in circulation:

A rumor is published here that the Grand Trunk Ry. is about to extend its line to Winnipeg via Fault Ste. Marie and Duluth, and that when this city is reached the line will be extended to the Pacific coast by means of the Manitoba & Northwestern to Prince Alberta, thence through the Peace River country and mountains to Fort Simpson on the Pacific coast. It is said further developments may be expected in the course of a few days. Should the Grand Trunk decide to make a start for the Pacific coast via the route indicated, it is altogether likely the road between Winnipeg and Duluth will follow the line of the Duluth and Winnipeg, a portion of which road is already constructed and running northwest from Duluth,

Chicago, Ft. Madison & Des Moines.—This railway, running from Ft. Madison to Colleth Station, Ia., 45 miles, has been changed to standard gage and opened for traffic. A press dispatch says:

Another railway is to be opened between Omaha and Chicago, to be operated by the Santa Fé. Part of the new line is to be built, but work is now advancing. The Ft. Madison & Northwestern road, a narrow gage line, was sold under foreclosure proceedings a few months ago, the purchasers being a syndicate of Chicago, Boston and London financial heavy weights. They reorganized the company under the name of the Chicago, Ft. Madison & Des Moines R. R. and widened the gage to standard width. Work was begun this year extending the line westward, and the road is now open and trains running between Ft. Madison and Libertyville. From Libertyville to Ottumwa, 23 miles, the line is graded and the track will be laid in a few weeks. West of Ottumwa the line makes a straight shoot for Omaha, the route being north of the Burlington main line and south of the Rock Island Trans-Iowa line, about equidistant from both, and for over 200 miles it runs through a belt where for 25 miles on either side it has no east and west lines to compete with.

Projects and Surveys.

Tamaroa & Mt. Vernon.—Chartered in Illinois to build a line of railroad from Tamaroa to Mt. Vernon, Ill., 20 miles. Among the incorporators are: H. Clay Horner, John C. Gerlash, Chas. E. Kingsbury and Jas. J. Morrison, all of Chester, Ill., where the principal offices will be located.

La Salle & Bureau County.—This company, recently incorporated by Chicago capitalists, has located its proposed road, and is now securing the right of way. The road will be about 10 miles long, and it is intended to transfer freight to the Chicago & Northwestern and the Chicago, Burlington & Quincy Rys.

Duluth, Mesabi & Northern.—The new survey for this Minnesota railway has been completed. The route selected runs from the confluence of the Artichoke and St. Louis rivers north to mines in Section 3, Township 58, Range 18, a distance of 48 miles. K. D. Chase, of Faribault, Minn., is President.

Collinsville & Alton.—A project is on foot to build a railway from Collinsville to Alton, Ill. Among those interested are: Judge Irwin, of Edwardsville, Ill., and H. C. Fisher, of St. Louis.

SOUTHWEST.—Existing Roads.

Missouri Pacific.—The bridges over the Red River at Alexandria, La., and the Ouachita River, at Columbia, La., are approaching completion. It is expected to have the first finished by Oct. 1. Tracklaying will begin as soon as the bridge is completed.

Kansas City & Independence Air Line.—All but about 1½ miles of the grading has been completed on this line between Kansas City and Independence, Mo., 5½ miles.

Projects and Surveys.

Houston & Velasco.—Col. S. Taliaferro, of Houston, Tex., is agitating the construction of a railway from Houston to Belasco, Tex., 60 miles.

Dardanelle & Mt. Nebo Incline.—A project is on foot to build a railway from Dardanelle, Ark., to the foot of Mt. Nebo, 5½ miles, with a 3,400 ft. incline up the mountain. W. J. Thompson, Dardanelle, Ark., is interested.

Corsicana & Southeastern.—It is probable that the citizens of Corsicana, Tex., will raise the subsidy required by this company to aid in building its proposed railway from Corsicana to pine timber lands in Trinity Co. As soon as the money is raised it is stated that the work will begin.

Houk.—This railway company has been chartered in Arkansas to build a railway from Mammoth Springs, Ark., to a gap in the Boston Mts., thence south to Little Rock, Ark., and the Louisana state line. R. D. Luther, of Thayer, Mo., is interested.

ROCKY MT. AND PACIFIC.—Existing Roads.

Denver, Lakewood & Golden.—At a recent meeting of the directors the following officers were elected: President, Charles Welch; Vice-President, Samuel Newhouse, General Manager, Frank P. King; Treasurer, C. Hodges; Jr., and Secretary, H. J. Hersey. The road is practically completed, and will be opened for freight service at once, and for passenger service as soon as the necessary equipment arrives.

Rio Grande Southern.—President Otto Mears is reported as saying that this road would be completed from the north into Rio, Col., this season, but that the division from Rio, south, would not be completed until next year.

Great Northern.—The Seattle & Montana R. R. will be completed by Nov. 1. Work is being delayed on the Pacific extension by the desertion of the laborers. Tracklaying has qeen completed on the branch from Monarch to Neihart, Mont.

Projects and Surveys.

Everett, Granite Falls & Eastern.—Chartered in Washington to build a railway from a point at or near Port Gardner, Wash., to Colville, Wash., with branches, and to operate a steamboat line on the Snohomish River. Among the incorporators are: A. A. Allen, J. J. Folstad and F. M. Hendler. The principal offices will be at Everett, Wash.

Eaton Canon.—City Engineer Sedwick, of Pasadena, Cal., has run a preliminary survey for a railway through Eaton Cañon, near Pasadena, Cal., a distance of 14 miles. Peter Steel, of Pasadena, Cal., is at the head of the enterprise.

Oregon, Washington & Idaho.—Chartered in Oregon to open the Columbia River for navigation up to the mouth of the Snake River by building portages around the Cascades and The Dalles.

FOREIGN.

Cerro Blanco.—This narrow gage railway from Cerro Blanco Station to the Cerro Blanco mines in the Sierra Nevada Mts., 17 miles, is now about three-fourths completed.

China.—A press dispatch says:

Mr. Denby, the Minister of the United States to China, in a dispatch to the Secretary of State dated Pekin, July 28, 1891, states that an imperial decree has been issued sanctioning the extension of the existing Chinese railway from Liu Hsi to Shan-Hai Kuan. Liu Hsi is the present terminus of the road which runs from Tongshan, near Taku, on the Peiho River, to the Kaiping Mines. Shan-Hai-Kuan is a city situate on the Gulf of Liaotung, at the terminus of the Great Wall. The road will ultimately go to Moukden, the capital of Manchuria, touching probably Newchang. Hence, in course of time, it will go to the Songari River. Tenders are invited for an iron bridge 2,100 ft. long over the Lan River, north of Kaiping, and bids have been solicited in the United States.

Mexico.—Contracts have been let to F. A. DaCosta, of Eagle Pass, Tex., for building a narrow gage railway 43 miles long from Sierra Mojada to salt deposits at Laguno Jaco, on the borders of the States of Chihuahua and Coahuila.

CITY TRANSIT.

Electric Railways.—***Biddeford, Me.***—The Biddeford & Saco Ry. Co. will soon commence work.

Chelsea, Mass.—The Lynn & Boston Ry. Co. has petitioned for permission to build an electric road.

Tompkinsville, N. Y.—It is proposed to adopt an electric system for the street railway along the shore road of Staten Island. Mr. Erastus Wiman is interested.

Honeoye Falls, N. Y.—An electric line to Hemlock Lake is projected, to connect with the line to Rochester.

Greenbush, N. Y.—The North & East Greenbush Horse Ry. Co. has been authorized to adopt an electric system.

Mount Vernon, N. Y.—The board of village trustees has granted a franchise to the Westchester County Ry. Co., to run electric cars by the trolley system through the streets of that village. This road is to run between Yonkers, Mount Vernon and New Rochelle.

Philadelphia, Va.—It is reported that the Hestonville Passenger Ry. Co. may adopt a storage battery system.

Cincinnati, O.—An electric railway is expected to be built this winter via the Chesapeake & Ohio bridge to Covington, Millidale and Rosedale, 5 miles, and to Ludlow, Ky., 3 miles.

Knoxville, Tenn.—The Market Square & Southside Ry., 5 miles, will be built by a syndicate headed by S. W. Miller, of Findley, O.

Le Mars, Ia.—A franchise for an electric road has been applied for.

Portland, Ore.—The City & Suburban Ry. Co. will equip with an electric system the lines recently purchased from the Willamette Bridge Ry. and Transcontinental Street Ry. Co.

Ventura, Cal.—A franchise for an electric railway has been applied for.

Elevated Railways.—***Haverhill, Mass.***—The length of the proposed elevated road on the Meigs' system to Lawrence will be about 4½ miles.

Philadelphia, Pa.—It is reported that Mr. Esler, manager of the Northeastern Elevated Ry. C., has stated that work will be commenced soon.

Horse Railways.—***Philadelphia, Pa.***—The Roxborough Ry. will be extended to Plymouth.

Detroit, Mich.—A majority interest in the stock of the new Detroit Citizens Street Ry. Co. has been sold to a syndicate headed by D. M. Terry, of Detroit.

Salt Lake City, Utah.—A franchise has been granted for the Popperton Place and Fort Douglas road.

Companies.—Fayetteville Street Ry. Co., of Fayetteville, N. C.; president, J. T. Denny. Ogden State Ry. Co., of Chicago, Ill.; to build electric and cable railways in Cook, Du Page and Kane counties; president, H. C. Adville, $2,000,000. Jacksonville & Panama Rapid Transit Co., of Jacksonville, Fla., to build a street railway; T. T. Stockton, J. S. Bell and Mr. L. Broward.

BRIDGES, TUNNELS AND CANALS.

Bridges.—***Acworth, Ga.***—Bids will be received until Oct. 3 for building a bridge 130 ft. long over Altoona Creek. Address J. M. Stone.

Kennesaw, Ga.—Bids will be received until Oct. 3, for building a 65-ft. bridge Noonday Creek. Address J. M. Stone, Acworth, Ga.

Milledgeville, Ga.—Bids will be received until Oct. 5 for building a bridge 120 ft. long and 16 ft. wide over Fishing Creek. Address D. B. Sanford.

Covington, Ky.—There is considerable talk of constructing another bridge over the Ohio River, connecting

Covington and Cincinnati, O. R. W. Wilson, Newport Ky., is interested.

Oakland, Cal.—The Southern Pacific Co. will soon find it necessary to replace the Webster St. drawbridge of the narrow-gage, in Oakland, by a new structure, which will involve an expenditure of $250,000. The drawbridge has been settling and twisting so that it cannot be used with safety much longer.

HIGHWAYS.

Maine.—The County Commissioners of York Co. will lay out a new road from South Eliot to Kittery and Portsmouth, N. H.

Massachusetts.—The Berkshire Co. Commissioners and the Board of Selectmen of North Adams, have had located and staked out the new road between North Adams and Greylock village. It is 4,000 ft. long, 66 ft. wide, with a 30-ft. roadbed, and is to be finished by Nov. 15. It will cross the south branch of the Hoosac river twice with iron bridges 20 ft. wide with overhanging sidewalks 6 ft. wide, and the cost of the road and bridges, exclusive of the land damages, which will be paid by the county, is estimated at $13,000. This will be borne by North Adams, aided by a $1,000 contribution of Williamstown citizens and possibly by an appropriation made in aid of the work when finished by the county. Proposals will be opened by the Selectmen, Sept. 21.

New York.—The town of Greenburgh has closed a contract, at about $13,000, for macadamizing the highway between Tarrytown and White Plains.

Pennsylvania.—Macadamizing is in progress near West Chester. The citizens of Nether Providence have appointed a committee to consider the question of improved roads and the means of obtaining them; Powell Stackhouse, J. Howard Lewis and William Sharpless are on the committee. The Darby & Chester Telford Road Co., of Chester, has elected directors. A boulevard at Philadelphia, to extend from the public buildings to the park, is projected by G. B. Haines, George Burnham, and others.

Kentucky.—Proposals for repairing 8 miles of the old Louisville & Nashville turnpike road were received at the county court, Bowling Green, Sept. 15.

California.—A wagon road in Marin County is being built by convict labor. The road will extend from Tiburon to San Rafael.

WATER-WORKS.

NEW ENGLAND.

South Berwick, Me.—A franchise has been granted John M. Burleigh and others.

Concord, N. H.—The new 2,000,000-gall. high service reservoir will be built by G. W. Hendrick, Easthampton, Mass.

Lancaster, N. H.—A report on a supply from Garland Brook has been submitted to a village meeting.

Boscawen and Penacook, N. H.—A company has been organized with C. H. Amsden, President, E. E. Graves, Clerk, and J. C. Pearson as Manager. A survey will be made for a supply from Great Pond. A fire precint has been organized in Penacook.

Bradford, Vt.—The village voted on Sept. 11 to bond the town for $20,000 for works and elected five commissioners.

Northampton, Mass.—The sum of $5,000 has been voted to extend 8 and 6-in. mains.

Saugus, Mass.—An extension to the Vine St. section is said to be needed.

Millville, R. I.—There is talk of an outside company.

New Britain, Conn.—The plans for the new Shuttle-Meadow Lake dam call for a structure 600 ft. long, 33 ft. high, with heart-wall of concrete 2½ ft. thick at the top, with a batter of 1 in 20. The inner slope will be paved.

Rockville, Conn.—The company talks of increasing its supply and enlarging its works. H. W. Ayers is Engineer for improvements.

Stamford, Conn.—The company may raise a dam 6 ft.

MIDDLE.

Alfred Center, N. Y.—The village will vote Sept. 21 on the construction of works to cost not over $16,000.

Arcade, N. Y.—There is still talk of works here, but nothing definite seems to have been done. J. P. Myers, of Springville, is said to be interested in one scheme and the Planing Mill Company in another.

Buffalo, N. Y.—William Sooy Smith and A. Fteley have recommended that a portion of the bottom of the new reservoir be covered with 3 ft. of puddle, a division wall built, and other changes in the plans made.

Lancaster, N. Y.—The project for works to be built by the village has been defeated by one vote.

Mayville, N. Y.—It is reported that a contract for works will be let to Bixbey & Son.

Sea Cliff, N. Y.—The Sea Cliff Association will improve its works for an all-the-year supply, instead of for the summer only, by laying 8-in. mains, already bought.

Plainfield, N. J.—The borough of North Plainfield has contracted with the Plainfield Water Supply Co. for five hydrants.

SOUTHERN.

Waynesborough, Va.—A franchise has been granted to W. N. Fishbourne for water and electric lighting plants.

Newbern, N. C.—It is reported that the construction of works will soon be started.

Macon, Ga.—A bill has passed the House authorizing the city to issue about $400,000 of bonds for works. The present works are owned by a company.

NORTH CENTRAL.

Alliance, O.—The Water Committee has reported in favor of an 8-years contract with the company for 13 hydrants per mile at a rental of $40 each, and an extension of the mains into the Sixth Ward. The Council has adopted the report and negotiations will be made.

Cleveland, O.—Bids will soon be asked for the work preliminary to the extension of the intake tunnel from the present intake crib.

L'Anse, Mich.—It is reported that works are wanted.

Marea, Ill.—It is stated that the village will build works to cost about $10,000.

Moline, Ill.—It is reported that a new intake will be laid. The present pipe is 3,000 ft. long, in a rock trench.

Tuscola, Ill.—A vote in favor of works has been cast.

Tomahawk, Wis.—The contract for building the works has been let for $18,586.

NORTHWESTERN.

Beatrice, Neb.—The contract for improvements, excluding the pump, has been awarded to Godfrey & Meals, of Fremont, for $26,512.

Lake City, Minn.—Water and electric lighting plants are talked of.

Vermillion, S. Dak.—It is reported that the Council has revoked the franchise granted to S. V. Saleno & Co.

Fargo, N. Dak.—A dam is projected across the Red River, below the present dam.

Lander, Wyo.—It is stated that bids for a franchise are wanted. The town is near a mountain range and on a stream with an average fall of 100 ft. per mile.

Rawlins, Wyo.—The lowest bidders for the new works were Igo & Howard, $19,500. This firm will probably receive the contract.

SOUTHWESTERN.

Elgin, Tex.—The Mayor has been authorized to advertise for bids to build works.

Goldthwaite, Tex.—Works are wanted.

Orange, Tex.—Works are under consideration.

Ironton, Col.—The Ironton Water, Light & Power Co. has been incorporated; capital stock, $50,000.

PACIFIC.

Port Townsend, Wash.—The Council has appointed a special committee to arrange for issuing bonds, building works and buying the plant of the Mount Olympus Water Co.

Snohomish, Wash.—Bonds to the amount of $60,000 have been voted for works.

Ukiah, Cal.—Gravity works, to be owned by the town, are under consideration. Mr. Jamison, owner of the present works, has offered to sell them to the town for $20,000.

CANADA.

Springhill, N. S.—A report on gravity works will be made to the Town Council.

Sandwich, Ont.—The contract for works has been awarded to Miles Hunting, Hamilton, for $11,375.

Nelson, B. C.—Works are nearly completed. A dam has been built across Ward Creek.

ARTESIAN WELLS.

Appalachicola, Fla.—A well is talked of.

Colfax, Ill.—A tubular well will be sunk on the St. Boniface church property.

Tuscola, Ill.—A well will be sunk, probably in connection with the water-works recently voted for.

Mitchell, S. Dak.—A contract has been let to C. O. Hutchins, Woonsocket, for a well from 10 to 66 ins. in diameter, 1,000 ft. deep, at $2.50 per ft. if the well is satisfactorily finished, and at $1 per foot otherwise.

Forman, N. Dak.—A special election to vote on the issuance of $1,000 in bonds for a well has been petitioned for.

Rogers, Tex.—A company is to be organized to bore for artesian water. Address S. H. Hunter.

IRRIGATION.

Fall Brook, Cal.—The Pauba Land & Water Co. has offered to supply the Fall Brook Irrigation District with 2,000 ins. of water for $200,000.

Linda Vista, Cal.—J. P. Jones has been elected President, and G. K. Phillips Secretary of this district. A survey will be made.

Otay, Cal.—A district is projected.

Round Valley, Cal.—James Morton, J. N. Wright and others have formed a company to irrigate this valley. Water will be taken from North Tule River through a 3½-mile flume and a reservoir on Lewis Creek.

New Companies.—Big Cottonwood Ditch Co., Lander Wyo.; $10,000; to take water from the North Fork of the Big Popo-Agie River. Northern Wyoming Canal Co., Sheridan Co., Wyo.; H. C. Alger, B. F. Perkins and others; to take water from Tongue River and tributaries to irrigate 75,000 acres at estimated cost of $400,000. San Juan Irrigation & Improvement Co., Olio, N. M.; $150,000; I. H. Green, S. H. Coolidge and others. Mimbres Canal and Deming Water Co., Deming, N. M.; $500,000; P. R. Smith, C. H. Dane and others.

SEWERAGE AND MUNICIPAL.

Sewers.—*Maine.*—Biddeford. The council has recommended extensions of the sewerage system.—Gardiner The Highway Commissioners have made a contract with Mr. Frederic Danforth for making surveys and plans for sewerage.

Massachusetts.—Revere. The State Board of Health has declined to approve the plans for sewage discharge, and recommends the town to pump the sewage into the sea at a considerable distance from the shore, or to connect with the Boston metropolitan system.

Connecticut.—Meriden. The sewerage committee, which has visited disposal works and had estimates prepared, has reported in favor of a separate system, conveying the storm and surface waters into the streams, and disposing of the sewage by surface irrigation. Mr. C. P. Bassett has made a report, and his estimate for 36-in. trunk sewers, based on Mr. McKenzie's plans, is $128,000.

New York.—Glens Falls. The Sewer Commissioners have received a report on the proposed sewerage system from Mr. S. E. Babcock, and have submitted it, with plans to the State Board of Health.—Middletown. A sewer is projected on Monhagen Ave.—Clinton. A report on the proposed sewerage system has been made by Mr. A. M. Scripture, C. E. A Board of Sewer Commissioners has been appointed.—Hornellsville. The Sewer Commission has accepted the proposition of Mr. C. P. Bassett, of Orange, N. J., to make surveys for the proposed sewerage system.—Niagara Falls. A Board of Sewer Commissioners has been appointed; president, Geo. W. Wright. The proposed sewer system will be 17 miles long when completed.—Williamsburg. A sewer is to be built in N. 15th St. at a cost of $108,000.

New Jersey.—Jersey City. The commission on the joint sewer between Jersey City and West Hoboken has been organized, with J. F. Nolan, Chairman; Engineer, James Moylan. The sewer will discharge into the Hackensack River.—Summit. The contract for the sewerage system has been awarded to Condon & Conley, of Jersey City, N. J., at $39,036, and for preparing the ground for the disposal works to J. W. Hughes, of Summit, at $10,210. Mr. C. P. Basset is Engineer.

Virginia.—Roanoke. The council has appropriated $15,000 for work on the intercepting sewer, and proposals will be advertised for.

Tennessee.—Knoxville. Plans for a system of sewerage for the entire city have been prepared, and it is proposed to employ an expert to examine and report upon the proposed system. Mr. M. Nicholson is City Engineer.

Georgia.—Athens. An ordinance on sewer connections has been adopted.

South Carolina.—Columbia. A company has made a proposition to establish a system of sewerage, the city to require property owners to make connections.

Michigan.—Ann Arbor. The council has accepted the report of the committee a sewerage.

Illinois.—Ottawa. Plans for a complete system of sewerage have been prepared by Mr. A. Rosewater, of Omaha, Neb. The cost is estimated at $50,000 to $75,000.—Monmouth. The city engineer's plans for the proposed sewerage system have been approved by Mr. G. F. Wightman, City Engineer of Peoria.

Iowa.—Creston. A proposition has been made by J. S. Roseberry to prepare plans and specifications for the extension of the sewerage system.—Sioux City. Mr. Wingeland, City Engineer, is preparing the plans for the new West Side sewerage system which the council recently decided to put in. His investigations have led to the conclusion that two distinct systems will be necessary. The section lying south of Palmer St. will be drained into the Missouri River and that north of Palmer St. into Perry Creek. The north system will be a combination of storm and sanitary sewers; the other section will include both sanitary and storm systems, entirely distinct from each other.

California.—Santa Barbara. A sewerage system has been decided upon.—San Francisco. A sewerage system for the south part of the city is being laid out.

Washington.—Fairhaven. A trunk sewer is to be built at a cost of $24,000. It will be of brick, 4 × 6 ft.

Street Work.—*Vermont.*—Waterbury. The village has voted $2,200 for street improvements.

Rhode Island.—Providence. Eddy St. has been paved with vitrified brick on concrete foundation, with part cement and part sand filling. The work was done by the Rhode Island Concrete Co.

Connecticut.—New Haven. The Street Committee has decided to pave York St. with vitrified brick.

New York.—Syracuse. Crouse Ave. is being paved with vitrified brick, and the city engineer is insisting upon the tar filling being poured into the crevices, instead of being flushed over the surface and swept into the crevices with stiff brooms.

Virginia.—Roanoke. It is proposed to macadamize the streets.

Kentucky.—Louisville. The city engineer has advertised for proposals for brick paving and macadamizing.

Michigan.—Bay City. It is proposed to try brick paving on Fifth Ave.

Illinois.—Tylorville. The city council has passed an ordinance requiring property owners to pay three-fourths of the cost of sidewalks in front thereof. The material is to be: On the public square, concrete or stone; on most

public streets, brick or concrete. Property holders four blocks from the square will be permitted to lay plank walk.

Steam Heating.—*Des Moines, Ia.*—The Des Moines Heat & Power Co. is putting down mains to furnish steam for heat and power. The Holly system of the American District Steam Co., Lockport, N. Y., is being used.

Garbage Cremation.—*Milwaukee, Wis.*—The Smith Sanitary Co. has made a proposition to the council to burn the garbage in furnaces especially built for the purpose, without producing any malodorous smells, for a term of 5 years at the following expense to the city: First year, $20,000; second, $22,000; third, $24,000; fourth, $26,000; fifth, $28,000. If it is decided to use two or more furnaces, or crematories, the company will charge an additional $2,000 for each.

Bonds.—Ishpeming, Mich.; $50,000 for sewers. Pawtucket, R. I.; $20,000 for parks. Beatrice, Neb.; $35,000 for water-works, paving, etc. Central Falls, R. I.; $200,000. Orlando, Fla.; for street paving. Florence, Ala.; $100,000 for macadamizing county roads; T. L. Cannon.

ELECTRICAL.

Electric Light.—*Manchester, N. H.*—Proposals for electric lighting for 3 years will be received by the Street Lighting Committee on Sept. 25.

Providence, R. I.—It is proposed to establish a municipal lighting plant.

Portland, Conn.—The German Electric Co., of Boston, Mass., will put in an electric light plant.

Little Falls, N. Y.—It is proposed to raise $30,000 for electric lighting.

New Brighton, Pa.—The contract for lighting the city for 5 years with 60 arc lights of 1,200 c. p. has been awarded to the Beaver Valley Electric Light Co., at $59 per light per annum.

Youngstown, O.—Proposals will be received for an electric light plant with 50 arc lights of 2,000 c. p.

Columbus, O.—The contract for 40 incandescent lights in the council chamber has been awarded to the Edison Electric Light Co., at $150 per annum.

Companies.—Pulaski Electric Light Co., of Pulaski, Va.; President, J. R. Miller; Secretary, R. B. Berkeley; $5,000. Cambridge Electric Light & Power Co., of Cambridge, Mass.; President, A. B. McNish; Secretary, W. L. Hitchcock; $7,000.

CONTRACTING.

Street Work.—*West Troy, N. Y.*—The contract for 6,000 sq. yds. of paving has been awarded to James Malone, of Troy, at $2.50 per sq. yd. for paving, 34 cts. per lin. ft. for bridge stone, 65 cts. per ft. for curbing.

Wilmington, Del.—The Street and Sewer Department has received proposals for 12,960 sq. yds. of brick paving: William Simmons, Wilmington; Porter's fire brick, $2.24 per sq. yd; Minor bricks, $2.40. Isaac S. Filbert, Baltimore; Dunbar brick, $2.25⅝; John W. Colburn, Baltimore, $2.12; Patrick Keltey, Baltimore; Western paving brick, $2.20; Pennsylvania Paving Co.; Chester square brick, $2.40; round corners, $2.50. John Jacoby, Wilmington; West Virginia brick, $1.85 and $1.90, 3 cts. per sq. yd. additional for New Cumberland brick. W. P. Clements & Co., Philadelphia; $2.14⅛. Thomas Cunningham, Philadelphia; New Brighton brick, $2 49. Charles D. Land, Philadelphia; $2.08 and $2.11. R. A. Woodbery, Wilmington; Barington brick, $1.88; Fair Hope, $1.93; New Cumberland, $1.95; New Brighton, $2.15; Toronto, $1.95; West Virginia, $2.09. James E. Tratt, New Brighton, $1.85.

Roanoke, Va.—The Street Committee has received proposals for 10,000 sq. yds. of brick and block paving: Virginia Asphalt Block & Concrete Pavement Co., Roanoke, $2.50 per sq. yd., with a maintenance of 5 years, $2.75 for 10 years, and $3 for 15 years; Keeling, Ridge & Co., Pittsburg, $2.40 per yd. for Brady's fire brick and $2.40 for John Porter brick; D. A. Langhorn, Lynchburg, $1.80 for vitrified brick, with a maintenance of 5 or 10 years; James D. Sanders & Co., $2.74 for James River sand brick and $2.65 for new Cumberland brick, maintenance of 1 year.

Ottawa, Ill.—The contract for Ottawa brick paving has been let to the Kimball & Cobb Stone Co. at $1.45 per yd.; curbing, 57 cts. per ft.; concrete, $6 per cu. yd.; excavation, 25 cts. per cu. yd.; traveling, 50 cts. per yd.

Pipe.—*Troy, N. Y.*—The Water Board has awarded a contract for 4, 5 and 8-in. cast-iron pipe to R. D. Wood & Co., of Philadelphia, Pa., at $27.95 per ton.

Sewers.—*Boston, Mass.*—The following tables give the prices of the proposals received by the Metropolitan Sewerage Commission for three sections of the main sewer of the Metropolitan sewerage system, as noted last week. Section 20, in Medford, 9,130 ft. long, 16 ft. average depth, 4,300 cu. yds. of brick and other masonry; Section 23, in Everett, 2,300 ft. long, 25 ft. average depth, 1,800 cu. yds. masonry; Section 40, in Everett and Malden, 6,250 ft. long, 16 ft. average depth, 2,950 cu. yds of masonry. The bidders were as follows: *A*, H. C. Eyre, Boston; *B*, Richard Falvey, Somerville; *C*, National Construction Co., Boston; *D*, Dennis O'Connell, Dorchester; *E*, Thomas F. Maney, Quincy; *F*, B. H. Cram, Boston; *G*, Collins & Fitzgerald, Somerville; *H*, Moulton, O'Mahoney & Trumbull, Boston; *I*, Metropolitan Construction Co., Boston; *J*, R. A. Malone & Son, Philadelphia, Pa.; *K*, Collins & Ham, Boston; *L*, John Sheehan, Lynn; *M*, E. S. Safford, Boston; *N*, A. A. Hall, Boston. The contract for Section 20 has been awarded to John Sheehan.

Section No. 20.	Earth excav. and refill. Sewer, 56 × 61 ins. 1,400 lin. ft.	Earth excav. and refill. Sewer, 53 × 58 ins. 6,200 lin. ft.	Earth excav. and refill. Sewer, 2 ft. 1,530 lin. ft.	Rock excav. 50 cu. yds.	Masonry. Brick, American. 2,600 cu. yds.	Masonry. Brick, Portland. 1,100 cu. yds.	Masonry. Concrete, American. 200 cu. yds.	Masonry. Concrete, Portland. 200 cu. yds.	Masonry. Rubble-stone, Am. 200 cu. yds.	Spruce lumber in place. 40 M. ft. B.M.	Spruce piles driven. 500 lin. ft.	Earth excav. and refilling outside of trench. 500 cu. yds	Total.
	$	$	$	$	$	$	$	$	$	$	cts.	$	$
A..	8.96	8.96	2.60	5.00	13.00	15 00	6.00	8.00	7.00	30.00	0.18	0.60	128,414
B..	8.00	7.00	3.50	5 00	12.50	13.50	6.00	8.00	7.00	30.00	0.20	1.00	113.555
C..	5.25	5 90	3.75	5.00	12 35	14.00	5.25	7.00	5.00	30.00	0.15	1.00	102,652
D..	5 00	6.00	1.90	1.00	12.75	14.70	5 25	6.50	4 00	28.00	0.18	1.00	101.337
E..	4.75	4 75	2.00	2.00	13.75	15.50	5 50	6.75	6.00	30.00	0.25	0 80	97,335
F..	6.15	5.11	2.06	2 50	12.19	14.29	6.25	8.15	5.95	26.49	0.14	1.14	95,351
G..	5.00	4.75	2.25	0 50	12.50	14.00	5.60	7.50	6.00	28.00	0.18	0.75	93.202
H..	3.94	4.27	1.60	2.00	13.36	15.76	6.50	8.00	6.50	33.00	0.45	0.50	92,292
I..	5.29	5.14	2.42	5 00	11.25	13.76	4.95	7.25	2.00	25.00	0.14	0.75	91,897
J..	5 00	5.00	2.75	1.00	11.00	13.65	5 75	7.00	6.50	30 00	0.25	0 80	91.620
K..	4.15	4.09	2.29	4.00	12.39	14.50	5.33	6.87	5.00	27.00	0.10	0.75	87,980
L..	3.60	3.80	1.20	7.00	12.70	14.00	5.00	6.50	5.00	35.00	0.30	0.70	85,018
Sec. No. 23.	2,300 lin. ft.	lin. ft.	lin. ft.	50 cu. yds.	1,200 cu. yds.	300 cu. yds.	100 cu. yds.	100 cu. yds	100 cu. yds.	10 M. ft. B.M.	500 lin. ft.	100 cu.yds.	
M..	15.75	.....	.....	5.00	13.75	14.75	6.25	7 75	7.00	30.00	0.25	1.00	60,025
F..	11.55	.....	.....	2.50	11.93	13.87	5.60	7.49	5.75	26.92	0.14	0.99	48,418
I..	10.35	.....	.....	5.00	11.85	14.35	4.85	7.14	2.00	28.00	0.14	0.75	44,104
G..	9.25	.....	.....	5.00	12.65	14.25	5.35	7.00	5.00	30.00	0.13	1.25	43,205
J..	7.00	.....	.....	3.00	12.00	13.75	5.75	7.00	6.50	30.00	0.25	0.80	39,344
Sec. No. 40.	6,250 lin. ft.	lin. ft.	lin. ft.	50 cu. yds.	1,700 cu. yds.	600 cu. yds.	225 cu. yds.	225 cu. yds.	200 cu. yds.	10 M. ft. B. M.	500 lin. ft.	50 cu.yds.	
N..	7.75	.....	.....	3.00	13.25	15.34	6.50	8.00	7.50	30.00	0.20	1.25	86,104
K..	6.05	.....	.....	5.00	13.50	15.25	5.90	7.50	6.25	30.00	0.22	0.90	75,287
E..	5.75	.....	.....	2.00	13.75	15.50	5.00	6.87	6.00	30.00	0.25	0.80	73,408
D..	5.55	.....	.....	2.00	13.05	15 00	5.75	7.70	5.00	29.00	0.18	1.00	70,878
I..	4.87	.....	.....	5.00	11.65	11.25	5.25	7.55	5.75	28.00	0.14	0.75	63.797
H..	3.84	.....	.....	2.50	14.00	17.00	6 25	8.25	6 25	34.00	0.45	0.50	63,452
J..	4.50	.....	.....	1.00	12.00	13.75	5.75	7.00	6.50	30.00	0..5	0.80	61,818

PROPOSALS OPEN.

Reservoir and Pipe Laying.—*South Hadley Falls, Mass.*—Laying 12,000 ft. of 12-in. pipe, 14,000 cu. yds. embankment, 3,000 cu. yds. excavation, 1,400 sq. rods clearing, 30,000 ft. B. M. sheet piling, 300,000 brick; gatehouse and bridge. Board of Water Commissioners. Sept. 22.

Grading.—*New York, N. Y.*—Grading, fencing and in proving grounds at shafts and gatehouse. Aqueduct Commissioners, 280 Broadway. Sept. 23.

Street Work.—*Beatrice, Neb.*—About 20,821 sq. yds. of 2 courses brick paving on sand at $1.35; 20,280 ft. B. M. 2 × 14 in. oak lumber curbing at $30. F. S. Davis, City Engineer. Sept. 21.

Terre Haute, Ind.—Brick paving and stone curbing; 6,000 ft. of 31-ft. roadway and 5,800 ft. of 50-ft. roadway. F. H. Cooper, City Engineer. Sept. 29.

Road.—*North Adams, Mass.*—Bridges, masonry and grading of new county road to Greylock. Specifications prepared by A. W. Locke for the Berkshire Co. Commissioners. The Board of Selectmen. Sept. 21.

MANUFACTURING AND TECHNICAL.

Locomotives.—The Baldwin Locomotive Works, of Philadelphia, Pa., have delivered a ten-wheel compound engine to the Los Angeles Terminal, and a freight engine to the Marietta & North Georgia; they are also building consolidation and ten-wheel engines for the Lehigh Valley. The compound locomotive built by the Brooks Locomotive Works, of Dunkirk, N. Y., for the Lake Shore & Michigan Southern, has two cylinders 17 × 24 and 28 × 24 ins., and driving wheels 60 ins. diameter.

Cars.—The St. Charles Car Co., of St. Charles, Mo., has built 50 box cars for the St. Louis & Hannibal, 35 narrow gage freight cars for the Mexican National, and is building 30 passenger cars for the Chicago, Burlington & Quincy. The Missouri Car & Foundry Co., of St. Louis, Mo., has an order for 1,000 box cars of 60,000 lbs. capacity for the Chicago, Burlington & Quincy. The Duechting-McCray Refrigerator Car Co., of Chicago; Anderson Fowler, Robert Clegg and Wm. Duechting; $50,000. The Ohio Falls Car Co., of Jeffersonville, Ind., has an order for 150 box cars for the Savannah, American & Montgomery.

Car Heating.—The Leland Car Heater & Steam Coupler Co., of New York, has contracts for equipping cars on the New York, New Haven & Hartford and Housatonic railways.

L. Vaden & Co., of Washington, D. C., report that they are building the masonry of 3 bridges over the Walhonding River and 2 canal bridges on the Toledo, Walhonding Valley & Ohio R. R.; President, A. J. Warner; Chief Engineer, J. A. Hanlon, Coshocton, O.

The Central Construction Co. has been incorporated, and reports several contracts secured. It is now building water-works, electric light plant and street railway at North Baltimore, O. President and General Manager, W. S. Coon, Flick Building, Upper Sandusky, O.

The Ingersoll-Sergeant Drill Co., of New York reports that A. C. Douglas, who has recently completed two tunnels in Pennsylvania for the draining of the Ashland coal basin, has a contract with the Cataract Construction Co. for canal and other rock excavation, at Niagara Falls, and has begun work, putting in new Ingersoll-Sergeant piston inlet air compressors and drills. Rogers & Clements, the contractors for the main tunnel at Niagara Falls, have recently put in some Ingersoll-Sergeant drills and are said to be making rapid and satisfactory progress.

Byram & Co., of Detroit, Mich., exclusive manufacturers of the Colliau patent cupola furnace, report shipments to Cardena, Cuba; San Luis Potosi, Mexico, and Yokohama, Japan.

Companies.—Detroit Track Signal Co., of Detroit, Mich.; President, L. L. Barbour; Secretary, Philip Porter; $300,000. New Jersey Railroad Signal Mfg. Co., of Newark, N. J.; J. Wayland and W. H. Buckley; $50,000. Columbia Supply Co., of Springfield, Ill.; railway supplies; C. D. Leach, C. A. Cox and John Travers; $300,000. Lake Erie Construction Co., of Sandusky, O., to build railways, docks, etc.; J. A. Pannabaker, C. N. Wells and F. A. Moore; $20,000. American Tin Plate Co., of Indianapolis, Ind.; A. L. Conger, Akron, O.; W. B. Leeds, Richmond, Ind.; John T. Hazen, Cincinnati, O.; $300,000.

Metal Market Prices.—*Rails.*—New York: $30.75 to $31; old rails, $21 for iron and $17 for steel. Pittsburg: $30; old rails, $23.50 to $24 for iron and $17 to $18 for steel. Chicago: $31.50 to $33; light and street rails, $32.50 to $35; old rails, $23.25 for iron and $14 to $16 for steel.

Track Materials.—New York; steel angle bars, 1.75 to 1.8 cts.; spikes, 2.25 cts.; track bolts, 2.8 to 3 cts., with square and hexagon nuts. Pittsburg: splice bars, 1.75 to 1.8 cts. for iron or steel; iron or steel spikes, 2.15 to 2.2 cts.; iron track bolts, 2.75 cts. with square and hexagon nuts. Chicago: splice bars, 1.8 to 1.85 cts. for iron, 2 cts. for steel; spikes, 2.25 cts.; track bolts, 2.8 to 2.9 cts. with hexagon nuts.

Foundry Pig Iron.—New York: $14 to $18. Pittsburg: $14.50 to $16.50. Chicago: $14 to $16.50

Pipe.—Cast iron, $20 to $30 per ton. Wrought iron, discounts as follows, at Pittsburg: 52½ and 42½ per cent. on black and galvanized butt-welded; 62½ and 50 per cent. on black and galvanized lap-welded. Casing, 55 per cent.

Lead.—New York: 4.4 to 4.5 cts. Chicago: 4.3 cts. St. Louis: 4.2 cts.

Structural Material.—New York: beams, 3.1 cts.; channels, 3.1 cts.; angles, 1.9 to 2.1 cts.; tees, 2.45 to 2.75 cts.; sheared iron plates, 1.95 to 2.25 cts.; steel plates, 1.95 to 2.15 cts. for tank, 2.25 to 2.6 cts. for shell, 2.4 to 2.6 cts. for flange, 3 to 3.25 cts. for firebox. Pittsburg: beams, 3.1 cts.; channels, 3.1 cts.; angles, 2 cts.; tees, 2.6 cts.; universal iron mill plates, 2.05 cts.; sheared steel bridge plates, 2.15 to 2.2 cts.; refined bars, 1.8 to 1.85 cts.; steel plates, 2.1 cts. for tank, 2.35 cts. for shell, 2.55 cts. for flange, 3.9 to 4.25 cts. for firebox. Chicago: beams, 3.2 cts.; channels, 3.2 cts.; angles, 2.15 cts.; tees, 2.6 to 2.7 cts.; universal plates, 2.15 to 2.2 cts.; sheared steel plates, 2.2 to 2.25 cts. for steel; steel plates, 2.4 to 2.6 cts. for tank, 2.85 to 3 cts. for shell, 3 to 3.25 cts. for flange; 4.5 to 5.5 cts. for firebox; boiler rivets, 4.25 cts.